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FEDERAL R&D FUNDING BY BUDGET FUNCTION

ORIGINAL
COMPLETED

FISCAL YEARS 1988-90

REPORT PREPARED BY:

NATIONAL SCIENCE FOUNDATION
Directorate for Scientific, Technological, and International Affairs
Division of Science Resources Studies
Government Studies Group

Washington, D.C.
20550

NSF 89-306

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NOTES TO THE READER

This annual report provides information on Federal research and development (R&D) funding by functional classification. It includes only Federal funding of R&D programs; funding of R&D facilities, all non-R&D activities performed within functions that conduct research and development, and all budget functions in which no research and development is conducted are excluded. To facilitate examination of the relative importance of research and development in the overall Federal budget and the role of each function within the total Federal R&D effort, R&D program data are classified into the same budget functions used in the Budget of the United States Government.

Research and development budget authority[1] discussed in this report reflect the programs proposed in the initial 1990 budget set forth in January 1989 by the outgoing administration. The new administration's 1990 budget proposal, submitted in February 1989, primarily uses the initial budget as a base from which negotiations with Congress will proceed. Although several initiatives in the revised budget are likely to affect R&D funding, official R&D budget authority figures are not yet available.

All programs within the Federal budget are classified into functional categories. Funding for these 19 functions, plus allowances and undistributed offsetting receipts, comprise the budget total with no overlap occurring between functions or the agency programs within the functions. In a few cases, components of a major national effort, such as the National Aerospace Plane, are funded through multiple functions.

Functional categories and definitions used in this report are the same as those used in the Federal budget with one exception. The Federal budget function of general science, space, and technology has been divided into two research and development functions: space research and technology, and general science. Four Federal budget functions -- medicare, social security, general purpose fiscal assistance, and net interest -- have no research and development components and are therefore excluded from this report, except with respect to discussion of research and development as a proportion of total Federal budget authority. The agency/function crosswalk table presents a listing of the

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[1] Budget authority is the legal authorization that permits obligations to be incurred. Obligations represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when future payment of money is required. Outlays represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated.

AGENCY/FUNCTION CROSSWALK

AGENCIES	National defense	Health	Space research and technology	General science	Energy	Transportation	Natural resources and environment	Agriculture	Education, training employment and social services	Veterans benefits and services	International affairs	Commerce and housing credit	Community and regional development	Administration of justice	Income security	General government
Department of Defense (Military)	X															
Dept. of Health and Human Services		X							X						X	
Nat'l Aeronautics and Space Admin.			X			X										
Department of Energy	X			X	X											
National Science Foundation				X												
Department of Agriculture							X	X								
Department of the Interior							X									
Environmental Protection Agency					X		X									
Department of Transportation						X										
Department of Commerce							X					X	X			
Veterans Administration										X						
Agency for Int'l Development											X					
Department of Education									X							
Nuclear Regulatory Commission					X											
Smithsonian Institution									X							
Tennessee Valley Authority													X			
Department of the Treasury														X		X
Corps of Engineers-Civil Works							X									
Department of Justice														X		
Department of Labor		X							X						X	
Dept. of Housing and Urban Devel.													X			

SOURCE: National Science Foundation, SRS

agencies contributing support to the 16 individual research and development functions.

In the Federal budget, most funds for research and development are not labelled as such, but are included within general program funding. In order to determine the budget authority for Federal research and development, the Office of Management and Budget requires the agencies to submit data on their R&D programs. These data are reported in the form of an Exhibit A-11-44 and provide information on funding levels for basic research, applied research, and development, R&D support to universities and colleges, and R&D facilities. Special Analysis J: Research and Development, one of the annual budget documents, provides an overview of research and development in the budget along with brief descriptions of the R&D programs of the agencies that play a major role in Federal R&D funding.

This report provides more detailed information on R&D programs within each budget function and includes data on the initial budget that have become available after Special Analysis J was prepared. Over 500 R&D programs are identified with their actual budget authority levels for fiscal year 1988 and estimated or proposed budget authority for fiscal years 1989 and 1990. Information sources for this report are the Exhibit A-11-44s, individual agencies' budget justification documents, and supplemental information provided by agency staff.

The data in this report, with a few noted exceptions, are based on budget authority dollars rather than obligations or outlays since detailed agency research and development budgets with information at the program level often are available only in budget authority. Fiscal years are used throughout the report unless otherwise noted. The budget authority numbers are presented in millions of current dollars and rounded to the nearest million. Percent changes are computed using unrounded numbers. Details in tables may not add to totals because of rounding.

The report's overview section examines both the total R&D budget and the budget for basic research in the context of total Federal budget authority. The overview is followed by discussion of research and development activities conducted within each budget function. The budget functions are presented in descending order of their R&D budget authority for fiscal year 1990. Each section includes an overview of the function and a summary table, followed by more detailed tables and text describing the major R&D program areas within the function.

A series of historical tables covering Federal R&D funding by function for the period 1955-1990 and Federal basic research funding for 1978 through 1990 are included in the Appendix.

ACKNOWLEDGEMENTS

This report was prepared in the Division of Science Resources Studies (SRS) by the Government Studies Group (GSG) staff: Beverly Fleisher, John Tsapogas, Margaret Meredith, and Richard Bennof. Supervision, review, and guidance were provided by Margaret R. Gucza, Study Director, GSG, Charles H. Dickens, Head, Surveys and Analysis Section, and William L. Stewart, Director, SRS.

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RESEARCH AND DEVELOPMENT IN THE 1990 BUDGET: AN OVERVIEW

Federal research and development funding serves two purposes: to meet the direct needs of the Federal Government where the supporting agencies are also the principal users of the results, and to assist in meeting broad national needs, particularly where the private sector lacks sufficient incentives to invest in research and development programs that will ensure continued long-term economic growth and maintenance of national competitiveness. R&D activities are conducted by almost every agency within the Federal Government. Both the level of funding and the proportion of budget authority that goes toward research and development varies widely among agencies and across budget functions.

Total Research and Development

The proposed budget authority for all Federal research and development programs in 1990 is $67.8 billion, an increase of nearly 10 percent over 1989 estimated R&D budget authority of $61.8 billion. Budget authority for research and development grew 5 percent between 1988 and 1989. The proposed rise in R&D funding in 1990 reflects the Administration's recognition of the need for a strong base to support the Nation's preeminence in science and technology. The growth in R&D budget authority is double the 5-percent increase proposed for total Federal budget authority for all activities. For all budget functions in which research and development is conducted, the percent growth in R&D funding far outstrips the proposed 2-percent increase in these functions' total budget authority.

R&D budget authority as a percent of total budget authority for all Federal budget functions hovers around the 5-percent mark, where it has been for several years. It is increasing, however, as a percent of budget authority for those functions in which R&D activities are conducted. In 1989, research and development accounted for 8 percent of the budget authority for these functions; in 1990, it is proposed to be 9 percent.

Non-defense R&D budget authority is anticipated to grow 11 percent to $23.5 billion in 1990. This represents 35 percent of total Federal R&D budget authority. Defense-related R&D funding is scheduled to be $44.3 billion in 1990, a 9-percent increase over estimated 1989 levels. Despite the rise in the amount of funding, the share of the R&D budget going to defense-related activities will decline 1 percentage point from 1989 to 65 percent of total R&D budget authority.

The five largest budget functions with respect to research and development -- defense, health, space, general science, and energy -- together account for 94 percent of all Federal R&D funding. The defense, health, space, and general science functions are all scheduled to receive increased funding for research and development in 1990. Of the five, only the energy function is slated for decreased funding for R&D activities.

Budget authority for basic research across all functions is scheduled to rise 7 percent to $11.2 billion in 1990. The top five research and development functions account for 90 percent of basic research budget authority. The Federal Government has traditionally played a key role in supporting basic research since industry often lacks sufficient incentives to invest in high risk research of this nature. Under the proposed budget, however, growth in basic research funding will not keep pace with increases in overall research and development funding. This reverses the recent trend towards a greater proportion of R&D budget authority devoted to basic research.

Federal R&D budget authority by budget function
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$59,104	$61,823	$67,833	9.7%
National defense	40,099	40,574	44,295	9.2
Health	7,076	7,724	8,229	6.5
Space science and technology	3,683	4,589	6,146	33.9
General science	2,160	2,379	2,652	11.5
Energy	2,126	2,427	2,333	-3.9
Natural resources and environment	1,160	1,208	1,140	-5.7
Transportation	896	1,019	1,129	10.8
Agriculture	882	910	901	-1.0
Education, training, employment, and social services	285	343	347	1.2
Veterans benefits and services	195	212	199	-6.1
International affairs	224	141	170	20.6
Commerce and housing credit	122	134	132	-1.5
Community and regional development	108	77	79	2.3
Administration of justice	51	45	40	-11.0
Income security	23	27	25	-7.5
General government	15	15	17	13.2

SOURCE: National Science Foundation, SRS

The major factors affecting changes in R&D funding in 1990 are highlighted below by budget function.

- Defense R&D funding is proposed to rise by $3.7 billion, or 9 percent above 1989 levels. This growth will allow for continued expansion of many R&D programs including those related to the Strategic Defense Initiative and the Advanced Tactical Fighter. The Department of Defense's Balanced Technology Initiative and the Department of Energy's defense waste and environmental restoration R&D activities are slated for major funding.

- Health R&D programs are anticipated to increase 7 percent to $8.2 billion. All institutes at the National Institutes of Health, the Human Genome Project, the National HIV Program, and the Alcohol, Drug Abuse, and Mental Health Administration's R&D programs will receive greater support. Consumer and occupational health and safety programs' R&D funding will increase.

- Space R&D program funding is scheduled to grow by 34 percent to $6.1 billion. Additional funding of $1.2 billion for Space Station Freedom is a major contributor to the rise. Significant increases also are anticipated for the space science and space research and technology programs.

- General science R&D programs are slated to increase over 11 percent to $2.7 billion. The growth in funding is attributable to the Administration's plan to double the National Science Foundation's budget by 1993 and to support Science and Technology Centers, Engineering Research Centers, and Supercomputer Centers as well as to continue to provide strong support to the basic research activities conducted at the Department of Energy's numerous user facilities.

- Energy R&D programs' funding is scheduled to decline by 4 percent to $2.3 billion. The decrease is attributable to reduced support for many fossil energy, energy conservation, and solar and other renewable energy R&D programs because they are more appropriately funded by the private sector or state or local governments. These reductions will be partially offset by greater funding for the Clean Coal Technology Demonstration Project.

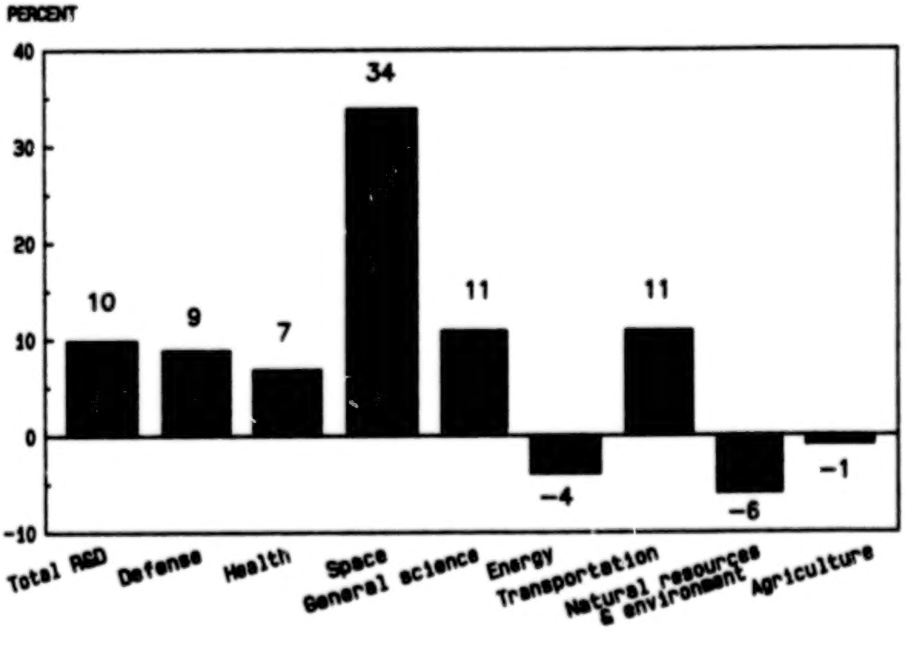
- Transportation funding for research and development is proposed to increase by 11 percent to $1.1 billion. The scheduled growth is largely attributable to air transportation activities including the National Aeronautics and Space Administration's systems technology programs and the National Aerospace Plane Project.

- o Natural resources and the environment's R&D budget is slated to decrease 6 percent to $1.1 billion because reduced support is requested for R&D programs conducted by the National Oceanic and Atmospheric Administration, the Bureau of Mines, and the U.S. Geological Survey. These reductions will be partially offset by requested increases in funds for pollution control and abatement, water resources-related programs, and conservation and land management programs.

- o Agriculture is scheduled to have its R&D budget decrease by 1 percent to $901 million because of a major reduction in funding for the Cooperative State Research Service. All other agriculture R&D activities are anticipated to receive modest increases in support.

- o When combined, the remaining 8 functions, each with less than $500 million in R&D budget authority, will increase 1 percent to $1 billion. Research and development in international affairs is slated to rise 21 percent. Education, community development, and general government are all expected to have R&D funding growth of less than 5 percent. Justice will experience the largest percent decrease of this group, with R&D budget authority declining 11 percent. Income security, veterans affairs, and commerce will all experience smaller percent declines in R&D funding.

Percent changes in major R&D budget functions:
fiscal years 1989-1990



SOURCE: National Science Foundation, SRS

R&D Budget Authority as a Percent of Total Budget Authority

In 1990, proposed R&D budget authority remains near 5 percent of total Federal budget authority for all functions within the Federal budget including those in which no R&D activities are conducted. It is, however, 9 percent of total budget authority for the functions in which research and development is conducted.

The proportion of budget authority scheduled for research and development varies greatly across functions from a high of 79 percent for general science to less than one-tenth of one percent for income security. Only two other functions, space and energy, have over 50 percent of their total budget authority devoted to research and development. Health and defense follow, with 14 to 15 percent of their budget authority scheduled for R&D activities. Of the remaining 11 functions, all of which have less than 10 percent of their total budget authority allocated for research and development, seven have less than 1 percent.

R&D budget authority as a percent of
each function's total budget authority

	1988	1989	1990
	actual	estimated	
All functions conducting R&D.........	8.2%	8.3%	8.9%
General science..........................	85.0	84.0	79.4
Energy..................................	38.5	42.4	64.5
Space science and technology.............	44.3	45.2	50.3
Health..................................	15.5	15.1	15.4
National defense.........................	13.7	13.6	14.1
Natural resources and environment.........	7.5	7.2	9.0
Agriculture.............................	4.8	3.6	4.4
Transportation...........................	3.2	3.5	3.9
Community and regional development........	1.2	1.2	1.2
Education, training, employment, and social services....................	0.8	0.9	0.9
International affairs....................	1.3	0.9	0.9
Commmerce and housing credit..............	0.5	0.6	0.8
Veterans benefits and services............	0.7	0.7	0.7
Administration of justice................	0.5	0.5	0.5
General government.......................	0.2	0.2	0.2
Income security..........................	0.0	0.0	0.0

SOURCE: National Science Foundation, SRS

Shares of Total R&D Budget Authority

In 1990, the five leading R&D functions -- national defense, health, space, general science, and energy -- account for 94 percent of all proposed Federal R&D budget authority. Transportation, natural resources and the environment, and agriculture each account for between one and two percent of the total. The remaining eight functions each comprise less than one-half of one percent of total Federal R&D budget authority.

Although defense research and development has declined from 68 percent of Federal R&D budget authority in 1988 to a proposed 65 percent in 1990, it remains more than five times larger than the second largest function, health. Energy and health also are scheduled to decline in their share of Federal R&D budget authority in 1990. While both space and general science will have a larger share of total Federal R&D funding, space's increase is dramatic, rising from 7 percent of total Federal R&D budget authority in 1989 to 9 percent in 1990. This growth in share largely is attributable to proposed funding to support research and development for the Space Station Freedom.

Functions' R&D budget authority as a percent
of total R&D budget authority

	1988	1989	1990
	actual	estimated	
Total	100.0%	100.0%	100.0%
National defense	67.8	65.6	65.3
Health	12.0	12.5	12.1
Space science and technology	6.2	7.4	9.1
General science	3.7	3.8	3.9
Energy	3.6	3.9	3.4
Natural resources and environment	2.0	2.0	1.7
Transportation	1.5	1.6	1.7
Agriculture	1.5	1.5	1.3
Education, training, employment, and social services	0.5	0.6	0.5
Veterans benefits and services	0.3	0.3	0.3
International affairs	0.4	0.2	0.2
Commmerce and housing credit	0.2	0.2	0.2
Community and regional development	0.2	0.1	0.1
Administration of justice	0.1	0.1	0.1
Income security	+	+	+
General government	+	+	+

+ Less than one-tenth of one percent.

SOURCE: National Science Foundation, SRS

Basic Research

The requested budget authority for basic research for all functions is $11.2 billion in 1990, 7 percent more than in 1989. Although basic research budget authority is anticipated to rise more than the 5-percent increase in total Federal budget authority for all activities and functions, it will not keep pace with expected growth in total R&D budget authority. Thus, in 1990, Federal support for basic research will decline as a proportion of total Federal research and development from 16.9 percent to 16.5 percent.

The top five research and development functions -- health, general science, space, defense, and energy -- are also the five largest basic research functions and account for 90 percent of basic research budget authority. They are followed by agriculture, natural resources and the environment, and transportation, which together account for more than 8 percent of basic research funding. The remaining 8 functions receive a total of over 1 percent of Federal basic research budget authority.

Budget authority for basic research by budget function
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$9,553	$10,449	$11,192	7.1%
Health	4,087	4,416	4,756	7.7
General science	2,061	2,268	2,525	11.3
Space science and technology	944	1,101	1,243	13.0
National defense	905	968	939	-3.0
Energy	571	614	634	3.2
Agriculture	428	438	457	4.3
Natural resources and environment	210	244	262	7.6
Transportation	197	249	226	-9.3
Education, training, employment, and social services	83	86	94	8.3
Commerce and housing credit	28	28	28	-1.8
Veterans benefits and services	17	19	15	-19.4
Administration of justice	8	10	6	-42.3
Community and regional development	7	5	4	-14.0
General government	5	3	3	17.2
International affairs	3	2	1	-72.2
Income security	0	0	0	0.0

SOURCE: National Science Foundation, SRS

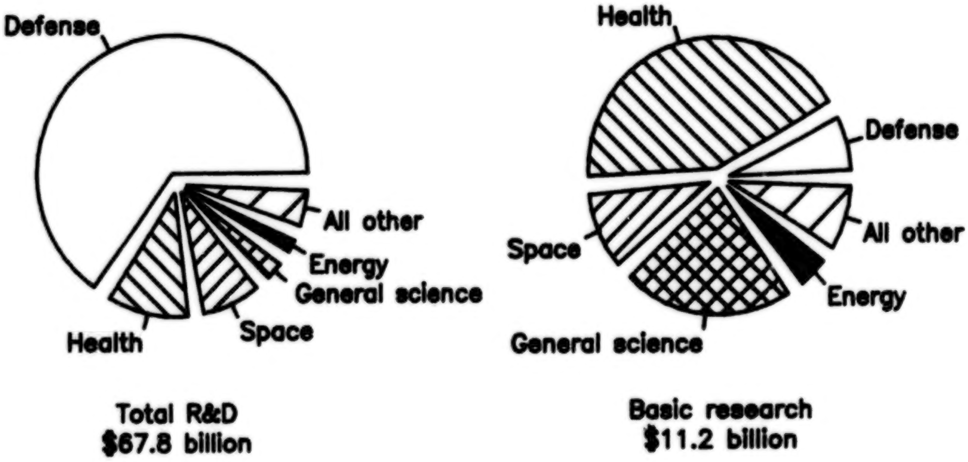
Three functions have more than 50 percent of their research and development budget authority directed to basic research. These functions are general science, with 95 percent, health, with 58 percent, and agriculture, with 51 percent of R&D budget authority used for basic research.

Health accounts for 43 percent of all Federal basic research but only 12 percent of total Federal research and development. Funding for health basic research is anticipated to rise 8 percent to $4.8 billion in 1990. At this level, basic research will comprise 58 percent of health R&D funding.

General science function basic research funding is 23 percent of all Federal funds for basic research. Ninety-five percent of all general science R&D funds are allocated to basic research. Basic research budget authority for general science will grow over 11 percent to $2.5 billion. Although it is among the top five functions for both total R&D funding and basic research funding, general science will receive only 4 percent of Federal R&D funds in 1990.

Space research and technology is expected to account for 11 percent of all basic research funding. This is a slightly larger share than the 9 percent of total R&D funds received by the function. Basic research funding will increase 13 percent to $1.2 billion in 1990. As a result of the extraordinary increase in total R&D budget authority proposed for space research and technology, however, basic research will decline as a proportion of R&D activities in this function, down to 20 percent from 24 percent in 1989.

R&D and basic research budget authority by major function: 1990



SOURCE: National Science Foundation, SRS

National defense accounts for only 8 percent of Federal basic research but 65 percent of total Federal research and development. At $939 million, the proposed budget authority for basic research will be 2 percent of defense's total R&D budget. Both the level of funding and defense's share of total Federal basic research activities will be lower than in 1989.

Energy is slated for $634 million, or 6 percent, of Federal R&D funds that will be directed toward basic research. This represents an increase in the level of funding over 1989, but a drop in the share of total Federal basic research budget authority. As a percent of energy R&D funding, basic research has grown from 25 percent in 1989 to 27 percent in 1990.

Agriculture accounts for 4 percent of Federal basic research funds. In 1990, 51 percent, or $457 million, of agriculture's R&D budget authority is allocated to basic research. Despite an increase in the level of funding, agriculture's share of Federal basic research funds will decline from 1989.

Natural resources and the environment will experience a slight increase in its share of Federal basic research funds, keeping the function at 2 percent of the total. Of the function's R&D budget authority, $262 million, or 23 percent, is expected to be allocated to basic research. Although the function's total R&D funds are declining, basic research as a percent of the function's R&D activities is increasing over 1989.

Transportation is slated to receive 2 percent of Federal basic research funds. At $226 million, basic research comprises 20 percent of transportation's R&D budget authority. Both the level of funding for basic research and transportation's share of Federal basic research activities are lower than in 1989. In addition, basic research's proportion of total R&D funds within the transportation function is shrinking even as total R&D funding levels for the function are growing.

The remaining 8 functions in total account for 2 percent of Federal basic research budget authority. Many conduct virtually no basic research. Because of the low levels of funding for basic research in each of these functions, initiation or elimination of small projects can cause wide swings from year to year in the proportion of Federal basic research funds, level of funds, and proportion of the function's total R&D budget authority allocated to basic research.

NATIONAL DEFENSE

Research and development activities within the national defense function are funded by the Department of Defense's research, development, test, and evaluation programs and the Department of Energy's atomic energy defense programs. Defense research and development activities are designed to enhance both conventional and nuclear defense capabilities.

The national defense function is proposed to receive $44 billion in research and development funds in 1990, a 9-percent increase over 1989 funding levels. The Department of Defense's research and development activities are slated to receive 94 percent of defense R&D funds. The remaining 6 percent is for the Department of Energy's atomic energy defense research and development activities. Defense research and development accounts for 65 percent of total Federal R&D funding in 1990.

Although overall defense R&D budget authority is scheduled to increase in 1990, the funding request does include reductions in selected areas. Major changes proposed for R&D funding in 1990 are highlighted below.

- DOD's advanced technology development R&D activities are proposed to increase by $1.9 billion, or 33 percent, to $7.8 billion to provide for continued strong support of the Strategic Defense Initiative primarily under the direction of the Defense Agencies.

- R&D funding for DOD's tactical programs is scheduled for a 14-percent, or $1.8 billion, increase to $14.9 billion to continue supporting a broad spectrum of activities designed to enhance the capabilities of both conventional and nuclear forces.

- Funds for DOD's strategic program R&D activities are slated to decline by $853 million, or 13 percent, to $5.6 billion. The decline reflects termination or major cutbacks in R&D programs for the B-1B bomber, the SRAM II missile, and the Trident II missile and other projects for which the R&D phase of activities are nearing completion.

- DOE's atomic energy defense R&D activities are proposed to increase 3 percent to $2.5 billion in 1990. This $77 million increase is largely attributable to a $40 million rise in funding for weapons research and development and an over 50-percent increase of $31 million for R&D funding for defense waste and environmental restoration programs.

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R&D budget authority for national defense
[Dollars in millions]

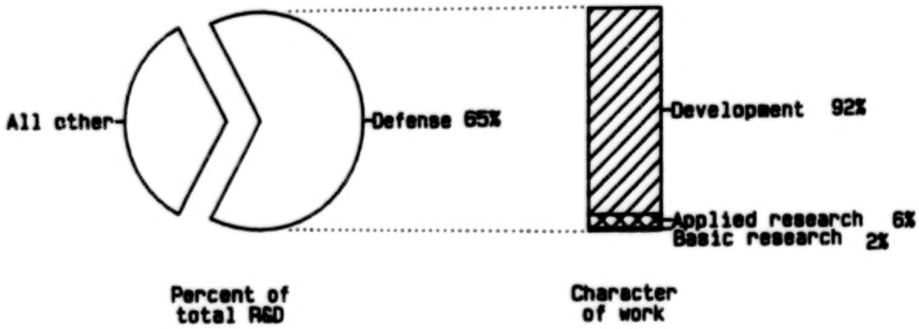
	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$40,098	$40,573	$44,295	9.2%
Department of Defense - military	37,654	38,115	41,760	9.6
Research, development, test and evaluation 1/	37,027	37,542	41,025	9.3
Tactical programs	11,998	13,169	14,943	13.5
Advanced technology development	5,356	5,897	7,840	33.0
Strategic programs	7,227	6,481	5,628	-13.2
Intelligence and communications	4,885	4,499	4,697	4.4
Defensewide mission support	4,251	4,019	4,625	15.1
Technology base	3,310	3,478	3,293	-5.3
Rescissions, reappropriations, and funds transfers 2/	627	573	735	28.2
Department of Energy - atomic energy defense activities	2,444	2,458	2,535	3.1
Weapons research, development and testing	1,557	1,568	1,608	2.5
Naval reactors development	532	542	549	1.3
Materials production	182	168	165	-2.1
Defense waste and environmental restoration	55	62	93	50.2
Verification and control technology	68	63	64	1.3
Nuclear safeguards and security	31	33	34	3.0
Program direction	20	21	22	1.9

1/ Detailed budget data for the RDT&E request are available only in Total Obligational Authority (TOA) which represents the value of the fiscal year's direct programs, regardless of financing.

2/ DOD accounting used to convert TOA to Budget Authority.

SOURCE: National Science Foundation, SRS

R&D budget authority for defense: 1990



SOURCE: National Science Foundation, SRS

Department of Defense - military activities

The Department of Defense's research and development programs support the improvement of equipment, intelligence, and personnel for the Nation's defense. The Departments of the Air Force, Army, and Navy, and the Defense Agencies, work individually and together to improve the defense technology base, develop advanced technology, and strengthen tactical and strategic programs, intelligence and communication, and defensewide mission support.

Funding for DOD's R&D programs are proposed to grow by 9 percent to $41 billion in 1990. Among the mission areas, tactical programs, advanced technology development, intelligence and communications, and defensewide mission support are all slated for increases in funding. Strategic and technology base programs will face reduced funding. Of the agencies and departments, the Defense Agencies will receive the largest percent increase in R&D funds, up 25 percent from 1989. They are followed by the Army, with a 10-percent increase, and the Navy, with a 9-percent increase. The Air Force, which receives the largest amount of R&D funds, will have the smallest percent growth in funding, 1 percent, in 1990.

In addition to ongoing modernization activities, several areas will receive increased attention in 1990. The Science and Technology Program will focus on chemical warfare and chemical and biological defense, superconductivity, and aircraft propulsion. To complement nuclear force upgrades, the Balanced Technology Initiative, which draws on all departments and agencies will continue; it is structured to advance technology considered important to the success of conventional defense missions. Additional efforts will also be made to ensure that DOD software technology programs keep pace with computer hardware technologies.

Tactical programs

Tactical programs provide for the enhancement of capabilities of conventional and nuclear forces. Tactical programs are proposed to receive a 14-percent increase in funding, to $15 billion in 1990. This represents 36 percent of DOD's R&D funding.

The Department of the Navy's budget request provides for continued work on the V-22A Osprey tilt-rotor aircraft, the Advanced Tactical Fighter, the P-3 modernization program, the advanced air-to-air missile, the Seawolf attack submarine, early warning systems, upgrading the F-14, and continued improvement of air, surface, and submarine based anti-submarine warfare abilities, including the SSN-21 submarine.

The Department of the Air Force plans to continue funding for the Advanced Tactical Fighter, the F-16, and the C-17 transport aircraft. Efforts will also focus on munitions used against hardened targets, development of TR-1 surveillance aircraft sensors and ground stations, and improvements in the

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R&D total obligational authority for DOD research,
development, test, and evaluation 1/
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$37,027	$37,542	$41,025	9.3%
Agency totals				
Department of the Air Force	15,058	14,679	14,772	0.6
Defense Agencies	7,814	8,401	10,465	24.6
Department of the Navy	9,479	9,345	10,184	9.0
Department of the Army	4,677	5,118	5,603	9.5
Tactical programs	11,998	13,169	14,943	13.5
Department of the Navy	5,589	6,107	7,021	15.0
Department of the Air Force	3,943	4,122	4,660	13.1
Department of the Army	2,250	2,703	2,913	7.8
Defense Agencies	217	237	349	46.8
Advanced technology development	5,356	5,897	7,840	33.0
Defense Agencies	3,976	4,497	6,397	42.2
Department of the Air Force	789	765	785	2.7
Department of the Army	355	442	464	4.9
Department of the Navy	235	193	194	0.6
Strategic programs	7,227	6,481	5,628	-13.2
Department of the Air Force	5,743	5,374	4,659	-13.3
Department of the Navy	1,232	790	521	-34.1
Defense Agencies	133	246	375	52.2
Department of the Army	119	70	74	6.0
Intelligence and communications	4,885	4,499	4,697	4.4
Department of the Air Force	2,136	2,064	2,087	1.1
Defense Agencies	1,741	1,633	1,672	2.4
Department of the Navy	903	749	849	13.3
Department of the Army	106	52	90	72.4
Defensewide mission support	4,250	4,019	4,624	15.1
Department of the Air Force	1,673	1,583	1,782	12.5
Department of the Army	1,127	1,117	1,275	14.1
Department of the Navy	773	719	798	11.0
Defense Agencies	677	599	769	28.4
Technology base	3,311	3,478	3,293	-5.3
Defense Agencies	1,070	1,188	903	-23.9
Department of the Navy	747	787	802	2.0
Department of the Air Force	773	770	800	3.8
Department of the Army	721	734	787	7.3

1/ Detail on DOD R&D activities is only available in total obligational authority (TOA) which represents the value of direct defense programs for each fiscal year.

SOURCE: National Science Foundation, SRS

Airborne Warning and Control System (AWACS). Funding for a follow-on tactical reconnaissance system will double. Programs will be initiated for the F-15E and F-117A squadrons and short range tactical attack missiles. R&D activities on the Joint Surveillance/Target Attack Radar System (JSTARS) will continue at reduced levels.

The Department of the Army's R&D activities in tactical programs will focus on continued development of advanced weapons systems, including the seek and destroy armament missile and fiber optic guided missile, and control systems for air defense.

The Defense Agencies will triple their budget for research and development in the joint remotely piloted vehicles program and increase funding for the Joint Tactical Information Distribution System (JTIDS). R&D programs in Joint Service Education and Training Systems will be initiated.

Advanced technology development

Advanced technology development program R&D funds are scheduled to rise 33 percent in 1990, to $7.8 billion. This percent increase, the largest for any of the DOD mission areas, is attributable to funding of multiple R&D aspects of the Strategic Defense Initiative (SDI) through the Defense Agencies.

Increased support will be given to materials research and electronics through the Defense Agencies' Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program. SEMATECH, a private sector consortium formed to maintain state-of-the-art semiconductor manufacturing capabilities in the United States, will be supported at the same level as in 1989. The Balanced Technology Initiative will continue to receive strong support through the Defense Agencies.

The Department of the Air Force's National Aerospace Plane Project, conducted in conjunction with NASA, also will receive increased support. Funding for research and development on combat vehicle and automotive advanced technology by the Department of the Army will more than double.

Strategic programs

Funding for strategic programs' research and development will decline 13 percent to $5.6 billion in 1990. Major reductions will occur in the Air Force's support of the Milstar Satellite Communications System. The R&D program for the B-1B bomber is completed as is the advanced development work on the short range attack missile II (SRAM II). Total support for ICBM modernization will decline by 9 percent. Despite reduced R&D funding for development of small ICBM's, Peacekeeper missiles, and silo basing, R&D funding for the Peacekeeper rail garrison will grow. Support for Minutemen squadrons will increase by 69 percent. The B-2 bomber continues to be a major program.

The Navy's 34-percent decline in funding for strategic program research and development results from reductions in the R&D component of Trident II, strategic communications, extremely low frequency communications, and satellite laser communications programs. These are partially offset by a new initiative in anti-satellite systems (ASAT) and increases in funding for the fleet ballistic missile system.

The Defense Agencies' R&D funds for strategic programs will increase 52 percent, in large part because of growth in funding for the air defense initiative.

Intelligence and communications

Intelligence and communications will receive a 4-percent increase in R&D funding, to $4.7 billion. R&D activities are directed towards improving defense intelligence and command and control systems. Efforts include the improvement of threat warning and surveillance sensors through the use of advanced signal processing technology, and continued work on satellite communication, surveillance radars, thermal imagers, and infrared search and track systems. The greatest percent increase, 72 percent, will go to the Department of the Army in support of terrain information systems and the satellite communications (SATCOM) ground environment.

Defensewide mission support

Defensewide mission support is scheduled to increase 15 percent to $4.6 billion in 1990. This program provides R&D support for ranges and test facilities and research and development activities related to improving test and evaluation capabilities. Research and development will continue on the use of technology to reduce manufacturing costs and to extend the life and capabilities of existing defense systems.

Technology base

Technology base research funding is expected to decline 5 percent to $3.3 billion in 1990. The overall decrease is due, in large part, to a 24-percent decline in funding for Defense Agencies' technology base activities for strategic and tactical technologies. The Department of the Navy's funds will rise by 2 percent, with small amounts of growth in all programs with the exception of anti-submarine warfare technologies and nuclear propulsion. The Department of the Air Force will see a 4-percent increase in funds, the majority of which will be directed toward rocket propulsion research. The Department of the Army is scheduled to receive 7 percent more funds for technology base research. Funding will increase for command, control, and communications technology and engineering technology, but will decrease for medical technology and aviation technology programs.

Department of Energy - atomic energy defense activities

In support of the Administration's national security policies, defense R&D activities by DOE are focused on four broad missions: support for the national security policies of the United States for a reliable nuclear deterrent, safe and environmentally sound operations, provision of safeguards and security for nuclear weapons, materials facilities, and information, and support of the nuclear research and development effort essential to the U.S. Navy.

R&D funding for DOE's atomic energy defense activities is proposed to increase by 3 percent, to $2.5 billion in 1990. Of these funds, 63 percent will be used to support weapons research, development, and testing. Defense waste and transportation management R&D funds will grow by 50 percent over 1989 levels, reflecting concerns with the environmental effects of nuclear materials and production byproducts.

Weapons research, development, and testing

R&D activities within the weapons research, development, and testing program ensure the scientific and technological integrity of the national nuclear weapons stockpile, develop producible weapons for the stockpile, sustain an innovative technical base for ensuring future weapons capability, and provide the scientific basis for avoiding technological surprise. R&D funds are scheduled to increase 3 percent to $1.6 billion in 1990. Activities will include research and development on nuclear directed energy weapons as part of the Strategic Defense Initiative, and the inertial fusion program. Research will also continue on the development of safe secure systems for transporting nuclear weapons and weapon components. Underground nuclear testing remains a high priority.

Naval reactors development

The naval reactors development program carries out nuclear propulsion development work essential to the U.S. Navy. R&D funds for this mission are anticipated to increase 1 percent to $549 million in 1990. Work will continue to improve existing, and develop new, submarine and surface ship reactors and plant components. Major efforts include an advanced fleet reactor that will incorporate many recent advances into reactors to power a new generation of nuclear-powered attack submarines.

Materials production

The materials production program's primary mission is to meet weapons program requirements. In support of this goal, R&D efforts are focussed on development of engineering improvements for environmental protection and safety concerns, process optimization to maximize production at minimum unit cost, and development of alternative production methods. The budget request also supports research leading to the introduction of special isotope separation technology in the mid-1990s. Funding for research and development in materials production is scheduled to decrease 2 percent to $165 million in 1990.

Defense waste and environmental restoration

A 50-percent increase in funding to $93 million is proposed for defense waste and environmental restoration R&D activities. The program provides for safe interim storage, processing, transportation, and ultimate disposal of radioactive and other hazardous wastes generated from nuclear materials production and naval propulsion. Funding is requested for the planning, design, development, and testing of integrated transport systems that meet DOE's department-wide nuclear material transportation requirements. Special emphasis is being placed on the development of means for permanent disposal of transuranic waste and the immobilization of high-level defense waste. Research continues on the environmental restoration of inactive hazardous or radioactive waste sites and facilities at all DOE defense installations.

Verification and control technology

R&D funding for verification and control technology will increase 1 percent to $64 million in 1990. Research priorities include development of seismic and satellite tools for verification of nuclear testing and other arms control treaties, detecting directed energy and chemical weapons, and developing an infrastructure to support assessment of threats to domestic nuclear facilities and weapons.

Nuclear safeguards and security

The nuclear safeguards and security program is charged with developing measures to assure effective protection of the DOE's nuclear weapons, materials and facilities. Funds for R&D activities will be $34 million in 1990, a 3-percent increase over 1989. A high priority is the development of an integrated program for physical protection, material control, and material accountability. This will involve improving the national nuclear materials data base system so that timely, accurate, and comprehensive safeguards and materials management data are available. Among the priorities is the development of a system to simplify complex data input. Additional resources will also be devoted to methods for improving personnel security programs.

HEALTH

The health function includes R&D activities under two broad categories: health, and consumer and occupational health and safety. All of these activities are supported by the Department of Health and Human Services (HHS) with the exception of the Occupational Safety and Health Administration within the Department of Labor.

Budget authority for health research and development is $8.2 billion in 1990, an increase of $505 million, or 7 percent, over the 1989 level. Programs within the health function comprise nearly three-fifths (58 percent) of the basic research that the Federal government supports.

Research and development activities of particular interest in the proposed 1990 request for health are highlighted below.

- A total of $6.4 billion for R&D activities is proposed for the National Institutes of Health, a 4-percent increase over 1989. This increase is based on funding that excludes research and development on the Human Immunodeficiency Virus (HIV) and the Acquired Immunodeficiency Syndrome (AIDS)[1].
  - A total of $100 million of National Institutes of Health's request has been designated for the Human Genome Project. This represents an increase of $72 million above the 1989 level.
- A total of $921 million is proposed for R&D activities within the National HIV Program, expanding the program by $198 million, or 27 percent, over the 1989 level.
- A total of $634 million is proposed for the Alcohol, Drug Abuse, and Mental Health Administration's research and development in 1990, a 5-percent increase over the 1989 level, excluding funds for AIDS and HIV.
- A total of $95 million, reflecting an increase of 8 percent, is proposed for R&D activities conducted in consumer and occupational health and safety programs.

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[1] The 1990 request for R&D funding for AIDS and HIV has been consolidated into a single account within the Office of the Assistant Secretary for Health. Funding for AIDS and HIV has been extracted from 1988 and 1989 agency data for comparability and a separate analysis is provided on AIDS/HIV.

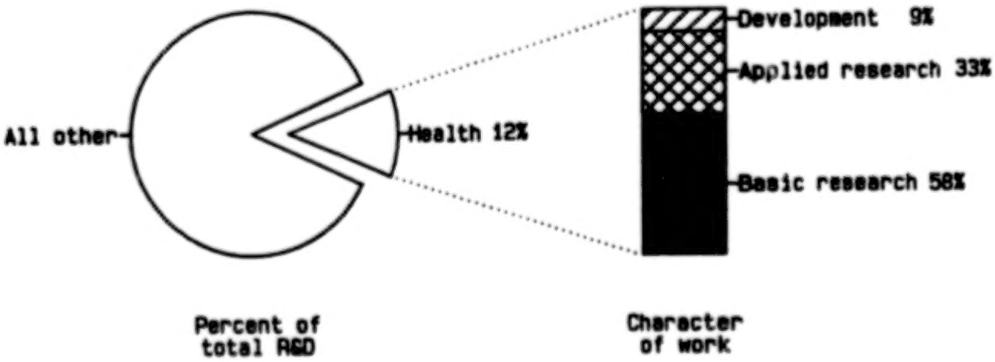
R&D budget authority for health
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$7,076	$7,724	$8,229	6.5%
Health programs (HHS)	6980	7620	8133	6.7
National Institutes of Health	5842	6195	6443	4.0
Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome 1/	551	723	921	27.4
Alcohol, Drug Abuse, and Mental Health Administration	498	604	634	4.9
Centers for Disease Control	59	72	72	-0.1
Assistant Secretary for Health	20	21	39	90.3
Health Care Financing Administration	10	10	14	41.4
Health Resources and Services Administration	10	10	10	1.0
Consumer and occupational health and safety	85	88	95	7.9
Food and Drug Administration (HHS)	81	84	91	8.3
Occupational Safety and Health Administration (Labor)	4	4	4	0.0

1/ HIV/AIDS R&D funding for 1988 and 1989 has been extracted from agency budgets for comparability with 1990 funding.

Source: National Science Foundation, SRS

R&D budget authority for health: 1990



SOURCE: National Science Foundation, SRS

Health programs

In 1990, growth in R&D activities is proposed for all but one health program. Health programs are expected to receive $8.1 billion, a 7-percent increase from 1989. The 1990 request augments funding for basic research, AIDS and HIV, and the Human Genome Project (HGP), and maintains funding for several existing activities.

National Institutes of Health

The National Institutes of Health (NIH) is the principal biomedical research agency of the Federal government and the largest component of the health function. The 1990 request proposes $6.4 billion for NIH, an increase of $248 million over 1989, excluding funds for AIDS and HIV. The request proposes a 7-percent increase in basic research, reflecting the view endorsed by the Administration and the university research community that basic research is vital for the accumulation of fundamental knowledge. In addition, it commits $100 million for the Human Genome Project, which provides a comprehensive and long-term approach to the mapping and sequencing of the human genome.

The principal R&D funding mechanism of NIH continues to be the research project grant (RPG), which, at the proposed level of $4.0 billion, accounts for 62 percent of the 1990 request. In 1990, NIH will support 19,773 RPGs, of which 15,217 are noncompeting[2] and 4,456 competing awards. The average RPG award amount will increase by 8 percent over 1989. A total of $552 million is proposed for 572 research centers, a net addition of two centers over the previous year. Funding is provided to establish three new specialized/comprehensive centers designated for the Human Genome Project and is expanded for the 78 general clinical research centers. Support for the balance of the centers will decline slightly. A total of $734 million is scheduled for intramural R&D, representing an increase of 6 percent proposed to offset rising costs.

All NIH components, except the Division of Research Resources (DRR) and the John E. Fogarty International Center, are proposed to increase in 1990. The principal reason for the decrease in funding for DRR is the proposed elimination of the biomedical research support program. The John E. Fogarty International Center is proposed is decrease slightly from 1989. R&D activities, excluding funds for AIDS and HIV, are discussed below for the five largest institutes.

National Cancer Institute (NCI): NCI's efforts are directed toward preclinical and clinical treatment research, diagnostic research, tumor biology, physical, chemical, and biological

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[2] Noncompeting grants are continuing grants that provide annual funding increments for multi-year grants.

R&D budget authority for the National Institutes of Health 1/ [Dollars in millions]

	1988 actual	1989 estimated	1990 estimated	Percent change 1989-1990 estimated
Total	$5,842	$6,195	$6,443	4.0%
National Cancer Institute	1,346	1,412	1,461	3.4
National Heart, Lung, and Blood Institute	899	966	997	3.2
National Institute of General Medical Sciences	559	602	688	14.2
National Institute of Diabetes and Digestive and Kidney Diseases	510	534	554	3.8
National Institute of Neurological Disorders and Stroke	508	455	473	4.0
National Institute of Allergy and Infectious Diseases	402	416	429	3.2
National Institute of Child Health and Development	364	388	401	3.4
Division of Research Resources	290	307	261	-15.1
National Eye Institute	215	220	228	3.3
National Institute on Aging	186	214	221	3.4
National Institute of Environmental Health Sciences	203	210	217	3.3
National Institute of Arthritis and Musculoskeletal and Skin Diseases	140	153	161	5.2
National Institute of Dental Research	117	122	126	3.3
National Institute of Deafness and other Communicative Diseases	-	-	89	**
Office of the Director	50	52	76	45.6
National Library of Medicine	21	25	27	6.9
National Center for Nursing Research	20	25	26	5.7
John E. Fogarty International Center	11	11	11	-5.4

1/ R&D funding excludes AIDS and HIV.

** Funding as a separate institute to begin in 1990.

Source: National Science Foundation, SRS

carcinogenesis, immunology, and epidemiology. The 1990 request provides $750 million for 3,009 RPGs (792 competing and 2,217 noncompeting). A total of $97 million is proposed for NCI's 60 research centers, the same number as in 1989. Intramural research is proposed at $254 million, an increase of 6 percent over the 1989 level.

National Heart, Lung, and Blood Institute (NHLBI): The NHLBI conducts and supports R&D programs that include basic investigations, clinical trials, and educational programs related to the cause, diagnosis, treatment, and prevention of heart, lung, blood vessel and blood diseases. The 1990 request for NHLBI provides $682 million in R&D funds for a total of 2,723 RPGs (591 competing and 2,132 noncompeting). In 1990, $87 million in R&D support is requested for research centers, a 1-percent decline from 1989. A total of $81 million is proposed for NHLBI's intramural R&D program, a 7-percent increase over 1989.

National Institute of General Medical Sciences (NIGMS): Investigations supported by NIGMS include a variety of studies in molecular genetics and gene expression. Research focuses on the relationship of structure to function in biological systems, such as the understanding of protein folding, the relationship between genetic makeup and diseases, and the impact of membrane structure on the immune system. Of particular importance in the 1990 request is the $99 million designated for the Human Genome Project administered by NIGMS. A total of $635 million will support 3,352 RPGs (721 competing and 2,631 noncompeting), 258 of which are for the Human Genome Project. A total of $19 million is proposed for 18 research centers, including $10 million to establish 3 new centers devoted to the Human Genome Project. Support for the remaining 15 centers is scheduled to decline slightly. Funding for NIGMS's intramural R&D program is proposed to increase by 6 percent over 1989.

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDKD): Basic and clinical investigations within NIDDKD are devoted to expanding the understanding of an extensive range of diseases including diabetes, other endocrine and metabolic diseases, and digestive, kidney, and urologic diseases and to studies in endocrinology, nutrition, and hematology. The 1990 request proposes $407 million for 2,066 RPGs (429 competing and 1,646 noncompeting). A total of $33 million is proposed for NIDDKD's 40 research centers, a slight decrease in funding from 1989. The intramural program is scheduled to receive $67 million.

National Institute of Neurological Disorders and Stroke (NINDS): Formerly the National Institute of Neurological and Communicative Disorders and Stroke, NINDS directs its R&D efforts toward the greater understanding of the normal and disordered function of the nervous system and the muscles. In 1990, the NINDS budget requests $341 million for a total of 1,922 RPGs (430 competing and 1,492 noncompeting). The budget request provides $22 million for

NINDS's 29 research centers, a 1-percent decline from the 1989 level. The intramural program is proposed to receive $60 million.

The National Human Immunodeficiency Virus Program

In 1990, $1.6 billion is proposed for the National Human Immunodeficiency Virus program. The National HIV program represents the research, education and prevention activities conducted and supported by the Public Health Service (PHS) agencies on AIDS and its causal agent, HIV. In 1990, PHS agencies' budget requests have been consolidated into a single account under the Office of the Assistant Secretary of Health (OASH) to aid coordination of the separate PHS agency efforts and enhance flexibility in response to changing priorities.

The 1990 request proposes $921 million for R&D activities within the National HIV program to be allocated to five PHS agencies (NIH, OASH, Alcohol, Drug Abuse and Mental Health Administration, Center for Disease Control, and the Federal Drug Administration). Although many agencies use the single term AIDS in reference to their program name, R&D efforts conducted by PHS agencies encompass activities on both AIDS and HIV. The 1990 request includes new and expanded activities in response to the recommendations made in the Presidential Commission's report on the HIV epidemic, the President's ten-point plan against HIV, and portions of the Health Omnibus Programs Extension Act of 1988. Funding for 1988 and 1989 AIDS and HIV R&D activities has been extracted from agency's budgets for comparability in analysis.

National Institutes of Health (NIH): The NIH request proposes $731 million for R&D on AIDS and HIV, an increase of $138 million over 1989. The NIH AIDS program supports R&D activities in all eighteen NIH components, which are coordinated through the recently established Office of AIDS Research. The majority (77 percent) of the program activities will be funded through the extramural grant mechanism. The 1990 request proposes $301 million for 738 RPGs (263 competing and 475 noncompeting). An additional $57 million will support 13 multidisciplinary research centers and contribute to several general clinical, biotechnology, and primate research centers. The intramural R&D program will receive $116 million.

The NIH AIDS program encompasses a broad array of basic and clinical research activities on AIDS and other forms of HIV infection and is divided into five research areas. The first areas is epidemiology, or the study of the distribution of AIDS in the population, and natural history, the patterns of evolution of disease. The second consists of identification and characterization of the etiologic agent, the virus that causes AIDS. The third is pathogenesis or the mechanisms whereby the virus destroys the immune system. Development and testing of

R&D budget authority for the Human Immunodeficiency Virus and the Acquired Immunodeficiency Syndrome 1/
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	**$551**	**$723**	**$921**	**27.4%**
National Institutes of Health	**451**	**592**	**731**	**23.3**
National Institute of Allergy and Infectious Diseases	223	311	399	28.2
National Cancer Institute	90	123	151	23.2
Division of Research Resources	52	44	45	1.6
National Heart, Lung, and Blood Institute	25	38	43	11.8
National Institute of Child Health and Development	17	22	27	23.3
National Institute of Neurological Disorders and Stroke	12	13	16	25.2
Office of the Director	6	13	12	-4.7
National Institute of General Medical Sciences	5	6	9	62.1
National Eye Institute	4	5	6	18.8
National Institute of Diabetes and Digestive and Kidney Diseases	3	4	5	50.0
John E. Fogarty International Center	5	5	5	6.5
National Institute of Environmental Health Sciences	4	4	4	7.3
National Institute of Dental Research	4	4	4	22.9
National Institute of Arthritis and Musculoskeletal and Skin Diseases	1	1	1	85.7
National Institute on Aging	(a)	(a)	1	125.0
National Center for Nursing Research	1	1	1	50.0
Alcohol, Drug Abuse, and Mental Health Administration	**61**	**80**	**132**	**64.2**
National Institute of Mental Health	31	46	67	44.6
National Institute on Drug Abuse	25	28	57	103.2
National Institute on Alcohol Abuse and Alcoholism	5	6	8	33.3
Centers for Disease Control	**28**	**29**	**33**	**15.8**
Federal Drug Aministration	**10**	**15**	**17**	**13.3**
Assistant Secretary for Health	**1**	**7**	**9**	**24.6**

1/ Data for 1988 and 1989 have been extracted from agency budgets.
(a) Less than $500,000.

Source: National Science Foundation, SRS

antiretroviral therapies (therapies for opportunistic diseases, and immunologic reconstitution (building up of the body's defenses) constitute the fourth. The fifth research area is development and evaluation of vaccines.

The majority (88 percent) of the NIH's effort is concentrated in four institutes: the National Institute of Allergy and Infectious Diseases (55 percent), the National Cancer Institute (21 percent), the Division of Research Resources (6 percent), and the National Heart Lung and Blood Institute (6 percent). The National Institute of Allergy and Infectious Diseases (NIAID) is NIH's lead institute for coordinating, conducting, and supporting R&D activities on AIDS and HIV. The NIAID program on AIDS and HIV includes six branches that support investigations on several aspects of AIDS infection including preclinical evaluation of therapeutic agents, development of vaccines, and studies on epidemiology, virology, molecular biology, and the immunopathogenesis of HIV. NCI is a major participant in NIH's AIDS program. The 1990 request enables NCI to continue R&D activities on the mechanisms of HIV-1 infection, the factors suspected to allow infection to progress, the influence of the immune response on the course of AIDS infection, the nature of growth factors in Kaposi's sarcoma and several studies of large population cohorts of infected and uninfected subjects in a variety of countries. DRR supports a wide array of AIDS-related clinical research in a network of general clinical research centers. NHLBI conducts studies pertaining to the protection of the blood supply, the prevention of transmission through transfusion, and the understanding of the disease in hemophiliacs and others who have acquired the disease through blood and blood products.

Alcohol, Drug, and Mental Health Administration (ADAMHA): The major area of concern of ADAMHA's AIDS program is intravenous drug abuse because of the size and pervasiveness of the high risk population of intravenous drug abusers. In addition, ADAMHA also supports R&D activities on neuroscience and behavior, pathogenesis, and clinical manifestations. All three of ADAMHA's institutes are involved in R&D activities on AIDS and HIV. The National Institute of Mental Health supports studies on neuropsychiatric, behavioral, and psychosocial effects of AIDS. The National Institute on Drug Abuse's program provides funds to assess the spread of the HIV virus, to address the needs of infected or symptomatic drug users, and to prevent the spread of HIV infection associated with intravenous drug abuse. The National Institute on Alcohol Abuse and Alcoholism supports investigations into the role of alcohol in the etiology of AIDS.

Centers for Disease Control (CDC): R&D activities conducted or supported by CDC on AIDS and HIV include epidemiological and laboratory studies to determine the natural history of HIV infection and to identify and monitor risk factors for HIV transmission.

Federal Drug Administration (FDA): R&D activities support studies on therapeutics, vaccines, and blood and blood products. R&D funding supports research and review capabilities in virology, epidemiology, biochemistry, and biophysics.

Office of the Assistant Secretary of Health (OASH): R&D activities conducted by OASH support the National Center for Health Services Research, which is concerned with the manner in which individuals with AIDS receive medical care, what kinds of care are provided, and the costs of medical care.

Alcohol, Drug Abuse, and Mental Health Administration

The Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) is the lead Federal agency for support and conduct of research on mental illness and substance abuse disorders. ADAMHA supports the majority of the Nation's biomedical and behavioral research on alcohol, drug abuse, and mental illness. The 1990 request proposes $634 million in 1990, $30 million more than in 1989, excluding funding for AIDS and HIV.

The majority of ADAMHA's R&D activities are supported through the research project grant (RPG) mechanism. The 1990 request provides $326 million for 1,769 RPGs, including 505 competing and 1,264 noncompeting. This is 55 fewer than in 1989 and with the proposed funding will yield a 4 percent increase in the average award amount. In 1990, ADAMHA is placing a high priority on R&D efforts at research centers. A total of $57 million is proposed to support 62 centers, 4 more than in 1989. Increases are included for centers involved with the National Plans for Research on Schizophrenia and the Brain and a new center in the National Institute for Drug Abuse to expedite drug development and coordinate collaboration with private industry. The 1990 request proposes $101 million for ADAMHA's intramural research program.

National Institute of Mental Health (NIMH): The NIMH conducts and supports basic and clinical research on mental disorders, mental health services research, and demonstration research programs for the prevention and treatment on mental illness. The 1990 request proposes $171 million for 919 RPGs (250 competing and 669 noncompeting). A total of $33 million will support 37 research centers, the same number as in 1989. NIMH's intramural program is proposed to receive $70 million in 1990.

National Institute for Drug Abuse (NIDA): The NIDA provides leadership and management for a national program on drug abuse. Extramural and intramural R&D programs at NIDA encompass basic research, clinical and epidemiologic studies, and treatment and prevention research. NIDA is proposed to receive $92 million for 488 RPGs (167 competing and 321 noncompeting). The request provides approximately $10 million for 14 research centers, one more than in 1989. NIDA's intramural program is proposed to receive $16 million.

R&D budget authority for the Alcohol, Drug Abuse, and Mental Health Administration (HHS) 1/
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$498	$604	$634	4.9%
National Institute of Mental Health 2/	286	326	341	4.8
Neuroscience	66	77	80	3.0
Moods, anxiety, and personality disorders	42	48	50	4.6
Schizophrenia	37	44	46	4.8
Behavioral science	24	25	26	2.4
Child and adolescent disorders	20	24	26	8.4
Mental disorders of Aging	19	23	25	8.9
Biometric/clinical research	11	13	13	3.1
Epidemiology/Psychopathology	10	11	11	1.8
Prevention research	8	8	9	3.7
Antisocial/violent behavior	8	8	8	1.2
Psychobiology	7	7	8	2.7
Minority health	4	5	5	4.1
Research management support	32	32	35	9.3
National Institute on Drug Abuse	121	160	168	4.6
Extramural research	98	130	135	4.1
Basic biomedical studies	35	42	43	2.4
Neuro-behavioral studies	33	40	41	3.3
Treatment research	11	22	24	6.8
Prevention research	12	17	18	5.9
Epidemiology	7	10	10	5.2
Intramural research	11	15	16	4.5
Research management support	12	15	16	9.3
National Institute on Alcohol Abuse and Alcoholism	84	111	116	4.8
Extramural research	62	86	91	5.5
Intramural research	12	15	15	0.0
Research management support	10	10	10	7.3
Office of the Director	8	9	16	74.2

1/ R&D funding excludes AIDS and HIV.
2/ Extramural and intramural data are not separately available.

Source: National Science Foundation, SRS

National Institute on Alcohol Abuse and Alcoholism (NIAAA): NIAAA supports a comprehensive research program to develop the knowledge for improving prevention and treatment of alcoholism and alcohol-related problems. In 1990, NIAAA will provide $62 million for 362 RPGs (88 competing and 274 noncompeting). A total of 11 research centers is proposed to receive $14 million. NIAAA's intramural program is scheduled to receive $15 million.

Other Health Research

Centers for Disease Control (CDC): CDC conducts research on disease prevention and risk reduction on sexually transmitted diseases, immunization, infectious diseases, chronic and environmental diseases, and occupational safety and health.

Office of the Assistant Secretary for Health (OASH): OASH conducts and supports research on the organization, financing, and delivery of health services and the understanding of the issues surrounding adolescent pregnancy.

Health Care Financing Administration (HCFA): HCFA supports research on alternate payment systems, quality of care, physician and hospital payment, program efficiencies, beneficiary awareness and prevention, and subacute and long-term care.

Health Resources and Services Administration (HRSA): HRSA R&D programs seek to improve the quality, effectiveness, and efficiency of services for mothers, children, and disabled children through the identification of methods for improving and delivering services.

Consumer and Occupational Health and Safety programs

Food and Drug Administration (FDA): The FDA supports research relevant to its mission of regulating food, drugs, biologics, medical devices and radiological products.

Occupational Safety and Health Administration (OSHA): OSHA conducts and supports research for the purposes of setting priorities and agendas for the completion and revision of standards, and for the development of an effective enforcement program. OSHA conducts evaluations of the environmental impact of all proposed standards, in addition to regulatory analyses of new OSHA standards.

SPACE RESEARCH AND TECHNOLOGY

Research and development within the space research and technology function is conducted by the National Aeronautics and Space Administration (NASA). The wide variety of R&D programs conducted by NASA reflect the priorities set by the National Space Policy. NASA is committed to establishing a permanently manned Space Station, continuing support of scientific investigations in space, and developing space technologies to meet the long-range goal of broadening human presence in space beyond near-Earth orbit.

In 1990, a total of $6.1 billion is proposed for space research and technology, an increase of $1.6 billion over 1989. Research and development has gained importance within this function, it accounts for 50 percent of the total budget authority for space in 1990. Major program increases in the 1990 request are highlighted below.

- A total of $3.0 billion is proposed for the space transportation systems program, 70 percent more than in 1989. The rise in R&D funding is attributable to an additional $1.2 billion requested for R&D activities related to the Space Station Freedom.

- The space science program will grow by $197 million to $1.7 billion in 1990.

    - Physics and astronomy will receive an additional $160 million in 1990.

    - Life sciences is scheduled for $46 million more than in 1989.

- The space research and technology program is proposed to receive $495 million, an increase of $56 million over 1989.

    - The Civil Space Technology Initiative's R&D funds will rise by $23 million.

    - A total of $16 million will be devoted to the startup of the in-space experiments technology initiative.

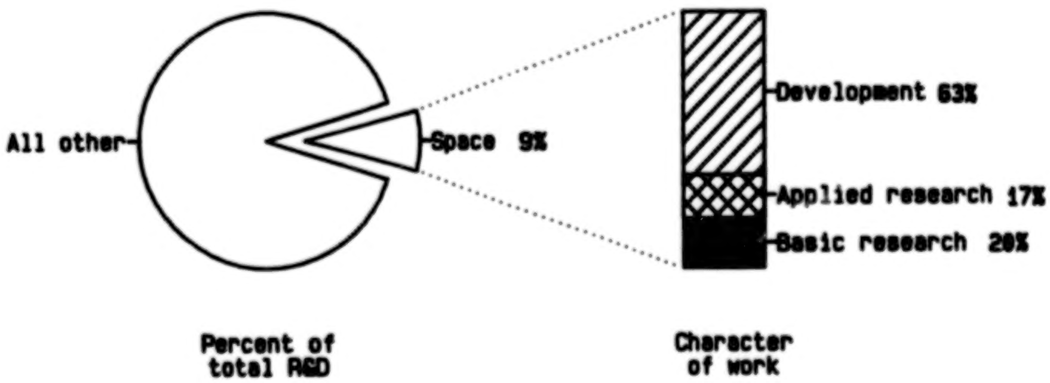
- Other areas of growth of particular note in 1990 are an additional $38 million scheduled for the safety reliability and quality assurance program and a $29 million increase planned for the transatmospheric research and technology program.

R&D budget authority for space research and technology
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$3,683	$4,589	$6,146	33.9%
National Aeronautics and Space Administration				
Space transportation systems	1,230	1,773	3,013	70.0
Space science	1,216	1,465	1,661	13.4
Space and terrestrial applications	698	731	710	-2.9
Space research and technology	353	438	495	12.9
Commercial programs and technology utilization	94	68	85	24.3
Safety reliability and quality assurance	32	42	80	88.7
Transatmospheric research and technology	41	50	79	58.0
Space tracking and data advanced systems	20	21	22	5.7

SOURCE: National Science Foundation, SRS

R&D budget authority for space: 1990



SOURCE: National Science Foundation, SRS

Space Transportation Systems

Space transportation systems (STS) includes two programs: Space Station Freedom (SSF) and the capability development program. The largest R&D activity within the space function, STS comprises 49 percent of the R&D funding for space research and technology and received the majority of the budget increase proposed in 1990.

Space Station Freedom program (SSF): The centerpiece of the civilian space program, the SSF will be a multipurpose, international research facility that will provide the United States with a permanently manned presence in space. The baseline configuration of SSF is a single horizontal boom structure with the U.S. laboratory and habitability modules, two international laboratories (one European and one Japanese), and a Canadian mobile servicing capability.

Development, the main program element in 1990, supports R&D activities of the baseline configuration of the SSF. The baseline configuration includes: pressurized habitation and laboratory modules with a shirt-sleeve environment and capabilities for conducting experiments under microgravity conditions, resource nodes linking modules, high power solar arrays, a truss structure to accommodate payloads and the Flight Telerobotics Servicer (FTS), extravehicular capabilities, and a polar platform carrying Earth observing instruments. Transition definition has two thrusts: system studies and analysis, and advanced development. System studies and analysis consists of definitional and developmental efforts to understand potential directions of the program and implications of these directions for current plans. During 1990, much of the effort within operations will consist of initial planning for integrated logistics and space systems operations. Research and development activities for the FTS, a highly-automated robotic flight system, include training, flight operations support, and integrated flight simulations. R&D design and construction efforts will begin on the orbital debris radar designed to monitor and characterize small-size orbital debris.

Capability development program: The engineering and technology base element provides the core capability required to sustain an engineering and development base for a variety of NASA activities of the manned space flight centers. In 1990, R&D funding provides an increase for sub-program level activities including safety, reliability, and quality assurance (SR&QA) requirements, an upgrading of engineering labs and support services, and the expansion of some computer capabilities. Funding of the Orbital Maneuvering Vehicle (OMV) will support ongoing hardware design and development, and finalization of specifications for critical design review in preparation for its scheduled 1994 flight.

R&D budget authority for space transportation systems
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total R&D 1/	$1,230	$1,773	$3,013	69.9%
R&D Plant	117	231	172	-25.7
Total R&D and R&D Plant	1,347	2,004	3,185	58.9
Space Station Freedom program	392	900	2,050	127.8
Development	367	842	1,970	134.0
Transition definition	4	12	25	108.3
Operations	-	-	25	**
Flight telerobotic servicer	22	46	15	-67.4
Orbital debris radar	-	-	15	**
Capability development program	593	681	639	-6.2
Engineering and technical base	134	155	190	22.1
Orbital Maneuvering Vehicle (OMV)	46	73	107	46.6
Spacelab	67	89	99	11.6
Upper stages	142	139	89	-36.2
Payload operations & support equipment	81	65	81	25.3
Advanced programs	46	53	49	-7.6
Tethered Satellite System (TSS)	12	26	20	-24.6
Advanced launch systems	65	81	5	-93.9
Research and program management	361	423	496	17.1

1/ R&D activity data are only available at the major program level; subprogram data include R&D plant.

** Proposed new initiative.

SOURCE: National Science Foundation, SRS

The Spacelab is a reusable facility installed in the cargo bay of the orbiter to enable scientists to conduct scientific experiments in the space environment. The growth in funding proposed for Spacelab reflects an increased frequency of scheduled flights. The upper stages element includes a variety of vehicles, such as the Inertial Upper Stages (IUS), Payload Assist Modules (PAM), and Transfer Orbit Stage (TOS), required to deploy payloads to orbits not attainable by the Shuttle or core stage expendable launch vehicles alone. The reduced funding level in 1990 reflects the support required for the TOS stage for the advanced communications technology satellite (ACTS) which is scheduled for termination in 1989. The payload operations and support equipment element provides unique hardware, analyses, and launch site support services for NASA missions.

The advanced program element includes preliminary design studies to increase the cost effectiveness of space flight systems. Development of the Tethered Satellite System (TSS) will continue in 1990 consistent with the planned engineering verification flight in early 1991. Advanced launch systems (ALS) is a joint DOD/NASA program to develop the next generation of unmanned launch systems. Using advanced technology, it will define a new heavy-lift capability aimed at reducing the cost of payload deployment. The proposed decrease in support of ALS results from no requested funding for propulsion activities. Since 1988, propulsion activities have been supported through transfers from DOD.

Space science

Three major programs fall under space science: physics and astronomy, planetary exploration, and life sciences. Space science activities use a variety of space systems supported by ground-based and airborne observations to conduct a broad spectrum of scientific investigations of the Earth, its space environment, the Sun, the planets, the stars, and the universe.

Physics and astronomy: This program consists of a combination of large free-flying space missions, Explorer spacecraft, Shuttle/Spacelab flights, and suborbital vehicles to study the universe, the fundamental laws of physics, and the formation of stars and planets. The mission operations and data analysis program element supports the operations and analysis data received from spacecraft during their missions. In 1990, the proposed funding for this element is required for operations and flight preparation for the Hubble Space Telescope. Research and analysis supports preliminary studies required to define missions and payload requirements. The growth proposed for Global Geospace Science (GGS), a part of the International Solar Terrestrial Physics (ISTP) program, supports the continued development of the GGS spacecraft.

R&D budget authority for space science
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total R&D 1/	$1,216	$1,465	$1,661	13.4%
R&D Plant	31	6	10	64.5
Total R&D and R&D Plant	1,246	1,471	1,672	13.7
Physics and astronomy	614	734	895	21.8
Mission operations and data analysis	141	143	205	43.0
Research and analysis	83	86	113	31.1
Global geospace science (GGS)	19	64	112	74.4
Explorer development	68	82	93	13.5
Shuttle/Spacelab payload mission management and integration	48	70	86	23.5
Payload and instrument development	47	82	71	-12.6
Hubble Space Telescope development	93	96	67	-30.1
Suborbital program	45	45	54	17.8
Advanced x-ray astrophysics facility development (AXAF)	-	16	44	175.0
Gamma Ray Observatory (GRO) development	53	42	27	-36.3
Space Station integrated planning and attached payloads	19	8	23	187.5
Planetary exploration	328	417	397	-4.7
Mission operations and data analysis	74	111	155	40.4
Mars observer	54	102	101	-1.7
Comet rendezvous asteroid flyby/Cassini	-	-	30	**
Research and analysis	67	77	79	2.9
Galileo development	52	73	17	-76.3
Ulysses	8	10	15	40.8
Magellan (Venus Radar Mapper)	73	43	-	*
Space life sciences	72	78	124	59.0
Research and analysis	38	40	54	33.2
Human space flight/systems engineering	-	28	43	55.1
Space biological sciences	-	10	28	173.3
Life sciences flight experiments	34	+	+	
Research and program management	232	242	256	5.8

1/ R&D activity data are only available at the major program level; subprogram data include R&D plant.

+ As of 1989, this program was divided into human space flight and systems engineering, and space biological sciences.

* Proposed for elimination.

** Proposed new initiative.

SOURCE: National Science Foundation, SRS

The 1990 request continues development activities related to or for the Explorer program, which consists of a number of missions that are exploratory or have specific objectives not requiring a major observatory. Some of the Explorer missions include: Extreme Ultraviolet Explorer (EUVE), instruments scheduled to fly on Combined Release and Radiation Effects Satellite (CRRES), the German Roentgen Satellite (ROSAT), Solar-A (a cooperative mission initiated with the Japanese to study the Sun during the upcoming Solar Maximum), Astro-D, and the first "small-class" explorer mission. In addition, development activities will begin on the X-ray Timing Explorer. The increase in R&D funding scheduled for the Shuttle/Spacelab payload mission management and integration program reflects the resumption of Spacelab missions with the flight of Astro-1 in 1990. Integration, testing, and evaluation will continue for other Shuttle/Spacelab missions.

The payload and instrument development element supports instrumentation for a variety of missions. The decrease in R&D funding proposed for the Hubble Space Telescope reflects the remaining activities required for final launch preparation before the December 1989 launch. The suborbital program, which consists of balloons, sounding rockets, and high-altitude aircraft, has received increased emphasis during the Shuttle recovery period. The 1990 request will support the continuation of the sounding rocket, Spartan, and balloon programs. In 1990, instrument development will be the focus of R&D activities within the Advanced X-Ray Astrophysics Facility development (AXAF). Launch preparations will be the chief activities for the Gamma Ray Observatory (GRO), scheduled for flight in April 1990. The 1990 request for the Space Station integrated planning and attached payloads element supports ongoing definition and development on the payloads selected for early flight on the Space Station.

Planetary exploration: The reductions in the 1990 request for the planetary explorations program reflect the approaching launch dates of several missions that offset significant increases for other programs and the initiation of the comet rendezvous asteroid flyby (CRAF) and Cassini missions. The increase proposed for the missions operations and data analysis element enables the continuation of operations and data analysis activities for the Pioneer, Magellan, and the Voyager missions. The Mars Observer mission will conduct geochemical, geophysical, and climatological mapping of the planet Mars over a period of one Martian year (approximately two Earth years) and is scheduled for launch in September 1992. The 1990 request for the Mars Observer enables the transition from design to fabrication of the spacecraft and its instruments. Development of the CRAF and Cassini spacecraft will begin in 1990. The CRAF mission will provide the first long-term investigation of a comet, obtaining information on its nucleus and the behavior of its ejected gases. The Cassini mission will make long-term observations of Saturn's atmosphere, rings, magnetosphere, and moons.

The research and analysis element supports the investigation of data obtained from current missions and Earth-based activities such as lunar sample and meteorite analysis, telescope observations, theoretical and laboratory studies, and instrument definition. Galileo, scheduled for flight using the Shuttle/Inertial Upper Stages (IUS) in October 1989, will conduct a comprehensive exploration of Jupiter. The Ulysses, a joint NASA/ESA mission, is designed to study the Sun at high solar latitudes that cannot be studied from the Earth's orbit. The 1990 request supports launch preparatory activities and periodic testing of instruments for the Ulysses, which will be launched October 1990. The termination of funds for the Magellan, which will obtain high resolution images of the Venus surface, reflects its scheduled Spring 1989 launch using the Shuttle/IUS.

Space life sciences: The proposed 1990 increase is distributed among all program elements. The space life sciences program includes studies concerned with fundamental biological processes and space-related medical problems through a variety of disciplines and techniques. The research and analysis program element is divided into five program areas: space medicine, space biology, controlled ecological life support systems, exobiology, and biospheric research. Funding for research and analysis also sponsors Specialized Centers of Research (SCOR) to support long-term, broad-based interdisciplinary research on high priority research topics. The chief aim of the human space flight and systems engineering program element is to ensure effective Shuttle and Space Station crew performance. The space biological sciences element pursues basic plant, animal, and human research necessary for a broad-based space biology program.

Space and Terrestrial Applications

The 1990 R&D budget authority for space and terrestrial applications is proposed at $21 million less than the 1989 level. Space and terrestrial applications consists of four discipline-oriented programs: Earth science and applications, materials processing in space, information systems, and communications.

Earth science and applications: The majority of the elements within the Earth science and applications program are scheduled for an increase in 1990. The 1990 request supports the continuation of development activities of the Upper Atmospheric Research Satellite (UARS). The UARS, scheduled for launch in 1991, will make comprehensive measurements of the stratosphere. Ongoing development will continue in 1990 on the spacecraft for the Ocean Topography Experiment (TOPEX). TOPEX is a collaborative effort with the French Space Agency (CNES) to utilize satellite radar altimetry to measure the surface topography of oceans. The Earth science payload program element develops and tests Earth-viewing remote sensing instruments and systems for basic research projects and conducts feasibility studies for major free-flying spacecraft. The proposed increase in 1990 supports several projects including the Measurement of Air Pollution from

R&D budget authority for space and terrestrial applications
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total R&D 1/	$698	$731	$710	-2.9%
R&D Plant	7	9	10	10.0
Total R&D and R&D Plant	705	741	721	-2.7
Earth science and applications program	389	414	434	5.0
Upper Atmosphere Research Satellite mission (UARS)	89	94	74	-21.5
Ocean Topography Experiment (TOPEX)	75	83	73	-12.3
Earth science payload instruments	28	46	67	43.3
Upper atmosphere research & analysis	33	31	38	22.5
Geodynamics	32	33	38	15.5
Atmospheric dynamics and radiation	31	32	37	16.9
Mission operations and data analysis	15	18	25	40.9
Oceanic processes research & analysis	20	21	25	17.8
Land processes research and analysis	21	20	23	13.1
Airborne science and applications	22	23	20	-14.3
Scatterometer (NSCAT)	23	11	14	30.2
Interdisciplinary research & analysis	1	2	2	4.5
Materials processing in space	63	76	93	22.6
Microgravity Shuttle/Space Station payloads	50	56	75	32.3
Research and analysis	13	14	13	-4.4
Commercial microgravity R&D enhancements	-	6	5	-8.9
Information systems	21	20	34	71.4
Data systems	10	10	18	91.7
Information systems	11	10	16	52.4
Communications	95	92	19	-79.8
Advanced communications research	14	12	13	6.7
Radio science and support studies	3	3	3	6.9
Communications data analysis	1	1	2	2.7
Search & rescue	1	1	1	-7.1
Adv. comm. technology satellite (ACTS)	76	75	-	*
Research and program management	137	139	141	1.2

1/ R&D activity data are only available at the major program level; subprogram data include R&D plant.

* Proposed for elimination.

SOURCE: National Science Foundation, SRS

Satellites (MAPS) experiment, the Active Cavity Radiometer-1, and the modification of a Total Ozone Mapping Spectrometer.

The upper atmosphere research and analysis element investigates and monitors the phenomena of the upper atmosphere and related phenomena in the lower atmosphere. Proposed funding for 1990 supports verification of the theoretical stratopheric models urgently needed for a better understanding of the relationship between ozone depletion and the amount of fluorocarbon released into the atmosphere. The 1990 request enables the continuation of comparative studies of balloon, aircraft, and ground-based measurement including analysis of the results from a recent aircraft mission to study ozone depletion over the Antarctic. Efforts supported under geodynamics strive to understand the origin, evolution, and current state of the solid Earth. The 1990 request will support the continuation of measurements of plate motion between North America and Europe, and motions of the Pacific plate.

The Earth sciences and applications program also includes research and analysis activities in four areas: the atmosphere, the ocean, the land, and an interdisciplinary category that conducts research on the interactions among these domains. In 1990 funding of the missions operations and data analysis element will support continuing operations of the processing of data from the Nimbus satellite. The Nimbus satellite produces data on ozone concentrations that will be used to estimate the occurrence of natural and man-made variations, sea-surface temperatures, aerosol measurements, and ocean productivity. The airborne science and applications element includes operation and maintenance of aircraft that support Earth-sensing and atmospheric research. Design and development activities will proceed on the NASA Scatterometer (NSCAT), which will acquire global ocean data for operational and research efforts by both military and civilian users.

Materials processing in space: This program provides a wide range of opportunities for microgravity experiments. The microgravity Shuttle/Space Station payloads element supports Space Station hardware definition and equipment development for both the first United States Microgravity Laboratory Spacelab mission and other appropriate commercial space facilities. The 1990 request enables the continuation of basic and applied research activities using STS mideck, Spacelab, and cargo bay experiments leading to several flights over the next few years. The research and analysis element provides the scientific basis for all current and future projects in the program. The commercial microgravity R&D enhancements program element supports development of the Metals and Alloys Solidification Apparatus and the Crystal Growth Furnace for flight on the United States Microgravity Laboratory series.

Information systems: This program provides advanced computer and information systems technology for the Office of Space Science and Applications. The increase in 1990 is attributable to the consolidation for science network communications previously funded in the individual space science and applications missions.

Communications: The reduction of R&D funding for communications is the result of the scheduled termination of the Advanced Communications Technology Satellite (ACTS), which the Administration regards as a more suitable undertaking by the private sector. The 1990 request continues the advanced communications research element that develops subsystem component technology required by NASA, other government agencies, and U.S. industry for advanced communication satellite systems.

The 1990 request supports ongoing development of optical and radio communications technologies necessary for future space communications satellite systems. The radio science and support studies element provides the technical basis for regulatory and policy development to assure orderly growth of existing and new satellite services. The search and rescue element is an international cooperative program that uses satellite technology to detect and locate aircraft and vessels in distress. Communications data analysis assists other Federal agencies in developing experimental satellite communications for emergency, disaster, and public service applications.

Space Research and Technology

The goal of space research and technology is to provide advanced technologies for future space missions. It is divided into the research and technology base program and three focused programs: Civil Space Technology Initiative (CSTI), Pathfinder, and in-space experiments technology (IN-STEP). All of the programs within space research and technology are scheduled to receive increases over the 1989 level with the exception of the research and technology base program.

Civil Space Technology Initiative (CSTI): CSTI was established in 1988 as one way to revitalize civil space capabilities. CSTI's objective is to develop new technologies to facilitate access to and increase the effectiveness of science missions in Earth orbits. The CSTI program focuses on three research areas: transportation, operations, and technology. Program elements include: propulsion, vehicle technology, automation and robotics, large structures and control, information technology, and power. The growth in 1990 for the vehicle element was proposed to support final design and initial fabrication of the aeroassist flight experiment (AFE). The AFE will study potential designs and technologies for increasing the payload of an aeroassisted transfer vehicle. Other program elements will remain at approximately 1989 levels.

R&D budget authority for the space research and technology program [Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total R&D 1/	$353	$438	$495	12.9%
R&D Plant	8	8	11	27.4
Total R&D and R&D Plant	361	447	506	13.1
Civil space technology initiative	114	122	145	18.6
Propulsion	24	36	37	3.6
Vehicle	15	13	36	170.7
Automation and robotics	25	26	26	0.0
Large structures and control	21	20	19	-3.1
Information technology	16	16	16	-1.9
High-capacity power	13	11	11	-3.6
Research and technology base	107	134	130	-3.0
Materials and structures	17	20	22	8.0
Space flight	21	21	19	-5.8
University space research	4	16	17	4.9
Propulsion	13	17	15	-8.4
Space energy conversion	12	14	13	-6.5
Aerothermodynamics	10	11	11	-3.7
Space data and communications	8	9	9	-5.4
Information sciences	7	8	8	-2.6
Systems analysis	5	7	7	0.0
Controls and guidance	5	7	6	-16.4
Human factors	4	5	5	-13.2
Pathfinder program	-	40	47	18.2
In-space operations	-	15	16	4.0
Mission studies	-	5	10	100.0
Surface exploration	-	9	9	9.4
Humans in space	-	5	6	5.0
Space transfer	-	6	6	10.9
In-space experiments technology program	-	-	16	**
Research and program management	140	151	167	10.9

1/ R&D activity data are only available at the major program level; subprogram data include R&D plant.

** Proposed new initiative.

SOURCE: National Science Foundation, SRS

Research and technology base: This program supports both exploratory activities and those of the focused programs. The base program consists of ten discipline elements: materials and structures, space flight, university space research, propulsion, space energy conversion, aerothermodynamics, space data and communications, information sciences, systems analysis, controls and guidance, and human factors. The program also sponsors a university space research program intended to enhance the Nation's engineering community and bolster the number of available qualified space engineers.

Pathfinder: An element of the new National Space Policy, the Pathfinder program is responsible for developing a broad set of technologies for future potential space missions beyond Earth orbit. The program is organized into four major technological elements: in-space operations, surface exploration, humans in space, and space transfer. In addition, a fifth element, mission studies, supports formulation of mission requirements and technology options. The 1990 request includes an increase for mission studies, and provides moderate increases for other program elements.

In-space experiments technology (IN-STEP): The purpose of IN-STEP is to provide validated advanced technologies to designers that will enhance the effectiveness and efficiency of current space systems and to advance future space missions. IN-STEP will provide the space environment necessary to test and validate highly-innovative technology concepts identified in the research and technology base program.

GENERAL SCIENCE

Research and development activities within the general science function are funded by the National Science Foundation (NSF) and the Department of Energy (DOE). General science programs contribute to developing the Nation's fundamental research base in science and engineering.

The general science function is proposed to receive $2.7 billion for research and development in 1990, more than an 11-percent increase over 1989 funding levels. Of the general science R&D funds, 95 percent are devoted to the conduct of basic research; 5 percent are allocated for applied research. No development work is done within the general science function.

The increase in funding for general science is attributable to the Administration's long-term plan to double the National Science Foundation's budget by 1993 and its commitment to significant support for research and education in science and engineering. Major changes proposed for R&D funding are highlighted below.

- NSF is scheduled to receive $1.9 billion, a 13-percent increase in funding for R&D programs in 1990.

- All NSF directorates will have increased funding with the largest percent growth, 26 percent, going to the computer information science and engineering directorate. This will provide research support to raise to 400 the number of institutions that can access NSF supercomputer centers through NSFNET.

- Centers and groups continue to receive funding emphasis. Eight new science and technology research centers will be established in 1990 with $15 million in funds. Support for research at the 11 Centers established in 1989 will be continued through the directorates. Funding for Engineering Research Centers' R&D programs will increase 22 percent and the number of operational centers will rise from 50 to 53.

- DOE expects an 8-percent increase in funding, to $771 million, for general science R&D programs in 1990.

- DOE's high energy physics program will have a 12-percent increase in funds to support research at two new facilities: the electron-positron collider at the Stanford Linear Accelerator Center, and the Tevatron proton-antiproton collider at Brookhaven National Laboratory.

- R&D funding for the Super Conducting Supercollider will decrease over 16 percent as the project moves out of the research and development phase into construction.

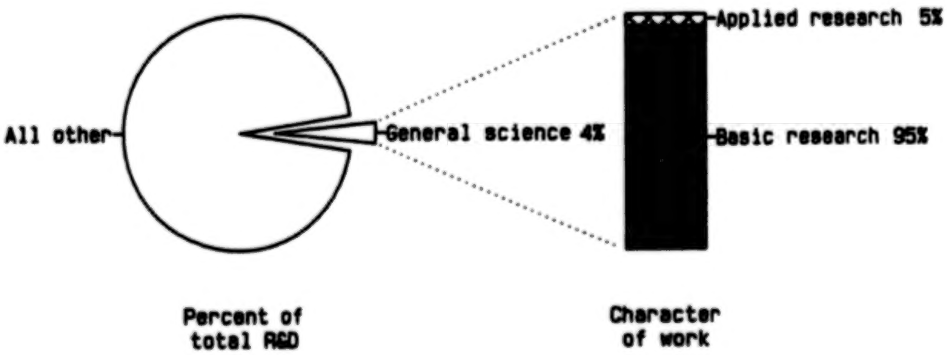
R&D budget authority for general science
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$2,160	$2,379	$2,652	11.5%
National Science Foundation	1,533	1,664	1,881	13.1
Mathematical and physical sciences	447	483	522	8.1
Geosciences	286	306	336	9.7
Biological, behavioral, and social sciences	265	280	313	11.7
Engineering	172	187	211	12.8
Computer information science and engineering	112	138	173	25.6
U.S. Antarctic program	113	118	136	15.1
Scientific, technological, and international affairs	46	54	61	13.6
Science and engineering education	13	15	16	7.4
Science and technology centers 1/	-	0	15	
Program development and management	80	82	97	18.2
Department of Energy	628	715	771	7.8
High energy physics	408	439	493	12.2
Nuclear physics	184	190	205	8.1
Superconducting Super Collider	33	83	69	-16.5
General science program direction	3	3	4	21.9

1/ Funds to support R&D activities at science and technology centers established in 1989 are assigned to the directorate with oversight once the award is made.

SOURCE: National Science Foundation, SRS

R&D budget authority for general science: 1990



SOURCE: National Science Foundation, SRS

National Science Foundation

NSF plays a pivotal role in promoting innovation through its support of the research infrastructure across a wide range of science and engineering disciplines and educational efforts. The knowledge base and skilled people produced by this infrastructure determine the pace of technological change and the maintenance of competitive positions in international markets. The Foundation continues to stress strengthening the disciplinary research base and improving academic science and engineering facilities, expanding the research activities of groups and centers, and developing human resources, broadening participation, and improving science and engineering education at all levels.

Funding for research programs in the Foundation is proposed to increase by 13 percent, to $1.9 billion, in 1990. Of these funds, 93 percent will be used to support basic research, primarily at universities and non-profit organizations. Special emphasis will be placed on studies related to global change, biodiversity, materials, and high performance computing. A major new facility, the High Magnetic Field Laboratory is proposed, as are 8 new science and technology centers.

A portion of the increased research funds within each directorate is being used for research on improving science and mathematics education and providing more research opportunities for students at both the graduate and undergraduate levels. These activities within the other directorates complement the work of the science and engineering education directorate. Research directorates also are being given funding and budgetary responsibility for the already-established science and technology centers for which they have oversight. Support for new science and technology centers established in 1990 will be funded by the science and technology centers activity. Responsibility and budget authority will be reassigned to the appropriate oversight directorate after the centers are selected and funded.

Mathematical and physical sciences

The mathematical and physical sciences directorate (MPS) supports research that leads to a better understanding of the physical laws governing the world in which we live. Research in the MPS disciplines, including mathematics, physics, materials research, chemistry, and astronomy, establish the knowledge base for future technological developments.

The 1990 request for research funding for the MPS directorate is $522 million, an 8-percent increase over 1989. MPS receives 28 percent of NSF research funding. The 1990 program continues emphasis on the mathematical sciences, high temperature superconductivity research, and research related to the Very Long Baseline Array radio telescope. A new research facility, the High Magnetic Field Laboratory, is proposed.

Physics: The physics program supports the development of new knowledge about the existence, structure, and interactions of the various forms of matter and energy, and about the basic forces that govern these interactions. The 1990 budget request includes increased funding for maintaining and upgrading facilities, strengthening disciplinary base research programs, and enhancing undergraduate activities.

Materials research: Fundamental research in superconductivity, advanced semiconductor research, computational materials science and engineering, and the emerging area of biological materials will receive increased support. Two new materials research groups will be established. Funding for a new National High Magnetic Field Laboratory, with state-of-the-art power supply and magnets, has been requested.

Chemistry: In 1990, support will be increased for selected research projects with unusually high potential. Two interdisciplinary initiatives -- materials chemistry and chemistry processing, and chemistry of life processes -- will be enhanced. Included in the initiatives are research projects on superconductivity, advanced materials for information technologies, the chemistry of the senses, and membrane chemistry. Additional support will be given for postdoctoral fellowships and undergraduate education programs.

R&D budget authority for mathematical and physical sciences
[Dollars in millions]

	1988 actual	1989 estimated	1990 estimated	Percent change 1989-1990 estimated
Total	$447	$483	$522	8.1%
Physical sciences	383	407	435	7.0
Physics	105	120	127	6.3
Materials research	111	114	124	8.9
Chemistry	94	97	103	7.0
Astronomical sciences	73	77	80	5.0
Mathematical sciences	64	66	76	15.5
Science and technology centers	-	10	11	8.0

SOURCE: National Science Foundation, SRS

Astronomical sciences: The astronomical sciences program supports research at universities and three national astronomy centers. Emphases in the 1990 plan include research on cosmology and the structure of the universe, technology development related to large mirrors, development of array detectors for optical and infrared observations in ground-based astronomy related to the Very Long Baseline Array, improved observational capabilities at millimeter and submillimeter wavelengths, preparation for a solar oscillations experiment related to the solar maximum of 1991, and continued efforts to attract students into research.

Mathematical sciences: Modern geometric mathematics, computational mathematics, and interaction with other disciplines will receive particular attention in 1990. Many of the activities will be carried out through significant enhancement of mathematical sciences research groups, an activity initiated in 1989.

Geosciences

The geosciences directorate (GEO) supports research that contributes to an understanding of the global environment and natural and human activities influencing that environment. The geosciences include atmospheric, ocean, and earth sciences. Activities conducted in the polar regions are also part of GEO. The principal focus of the GEO directorate is the Global Geosciences Program, one of NSF's contributions to the U.S. Global Change Research Program.

The 1990 request for research funding for the GEO directorate is $336 million, a 10-percent increase over 1989. GEO receives 18 percent of NSF research funding. Major increases are proposed for Global Geoscience Program activities including concentration on studies of climate, solid earth processes and changes in earth history, atmospheric chemistry, and upper atmosphere physics. The Continental Lithosphere Program, particularly studies of active tectonic processes, will also receive additional funding, as will scientific research in the Ocean Drilling Program.

Ocean sciences: Ocean science research support will focus on global change through interdisciplinary ocean studies. Particularly noteworthy are initiation of field activities in hydrography and geochemical tracers, continued preparation for the 1991 Global Ocean Flux Study Pacific field program, and establishment of an international office to coordinate participation in the world ocean circulation experiment. The oceanographic centers and facilities program element, which supports research at sea, will begin calibration of the Accelerator Mass Spectrometry Facility to begin hydrographic studies and to increase time series flux studies in the Pacific and Atlantic. The Ocean Drilling Program will emphasize development of techniques and instrumentation for measuring physical properties of the earth's crust.

Atmospheric sciences: Increases for the Global Tropospheric Chemistry Program, Coupling, Energetics, and Dynamics of Atmospheric Regions Program, and Tropical Ocean and Global Atmosphere Program will prepare for major field programs scheduled to begin in 1991. An initiative in mesoscale meteorology will begin. Support will increase for the Global Geosciences project. Activities at the National Center for Atmospheric Research will focus on studies to establish the scientific basis for the prediction of climates, the chemical constituents of the atmosphere, mesoscale meteorology, and solar and solar-terrestrial physics.

Earth sciences: Project support in the earth sciences involves the full spectrum of topics in the disciplines of geology, geochemistry, geophysics and paleobiology. In 1990, emphasis will be placed on studies of the physics and chemistry of earth materials, active tectonics, geohydrology, and the Earth's deep interior. The Continental Lithosphere Program will continue to pursue research on active tectonic processes by supporting the analysis of data obtained from drilling experiments, upgrading the network of global seismographs, and supporting continental scientific drilling.

Arctic research: The Arctic research program's scientific interest encompasses all aspects of the region's resources and environment. Among the research projects to be supported are the northern components of bipolar investigations, particularly in

R&D budget authority for geosciences
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$286	$306	$336	9.7%
Ocean sciences	135	146	153	4.6
Atmospheric sciences	91	95	104	10.0
Earth sciences	51	54	65	20.3
Arctic research	8	10	13	24.3
Science and technology centers	-	1	1	11.1

SOURCE: National Science Foundation, SRS

glaciology and upper atmospheric physics. Major increases in funding will go to the arctic systems science program, an element of the Global Geosciences Program that focuses on environmental change in the Arctic. Preparation will take place for a Greenland ice-coring project that will form the basis of a paleoclimate study. Detailed planning for coordinated research on land ecosystems and atmospheric interactions and high-latitude oceanic and atmospheric processes also will be supported.

Biological, behavioral, and social sciences

Biological, behavioral, and social sciences directorate (BBS) research programs seek to increase understanding of the ways chemical and physical events underlie fundamental life processes, provide insights into the interactions of biological systems and their environments, increase knowledge of the nervous system and the biological and cultural factors that influence the behavior of humans and other animals, and explain how various social and economic systems are organized and operate. Many BBS research areas are multidisciplinary.

The 1990 request for research funding for BBS is $313 million, a 12-percent increase over 1989. BBS receives 17 percent of NSF research funding. High priority areas in 1990 include biodiversity, biological databases, establishment of a national facility for biological computing, greater support for undergraduate research activities and research leading to course curriculum development, and continued support of new instrumentation and research resources.

Biotic systems and resources: As part of the overall initiative in biological diversity, increased funding will be used to initiate a special competition for innovative research to conserve and restore natural ecosystems, expand pilot projects for coordinated survey and collection of tropical organisms, establish a prototypic facility for analyzing worldwide distribution of plants and animals, enhance support for the Flora of North America Project, and develop new and expanded uses of remotely sensed data. Development of a comprehensive database for the flora of the northern hemisphere and establishment of linkages among disciplinary databases will take place as part of the biological database initiative. Among the continued research foci will be the reconstruction of evolutionary relationships, curation and computerization of natural history collections, the establishment and maintenance of long term ecological research sites, and microbial ecology as it relates to environmental safety, applications of biotechnology, and atmospheric levels of gases contributing to the greenhouse effect.

Cellular biosciences: Continued development of biotechnology and fundamental research on reproduction, development, growth, and physiological function will be the foci of cellular biosciences. Support will be strengthened for research in several areas: biodiversity; characterizing and regulating genes important in organism development; mechanisms by which cells of plants and animals receive, process, and respond to signals; and examining the use of biotechnological techniques to examine the biology of higher plants. Additional resources will also be devoted to multidisciplinary postdoctoral research opportunities, startup research funding in plant biology, and special supplements for undergraduate, graduate, and postdoctoral researchers to increase participation of under-represented minorities.

Molecular biosciences: This program area supports research on genetic approaches to the research problems that pervade the molecular biosciences and make a vital contribution to biotechnology and the understanding of fundamental mechanisms underlying photosynthesis and nitrogen fixation. Molecular biosciences will place additional support in plant molecular biology, development of innovative biochemical and genetic approaches to biotechnology, elaboration of molecular structure of important biological molecules using nuclear magnetic resonance and x-ray diffraction, and efforts to understand the molecular and genetic basis of biodiversity. Substantial additional support for undergraduate research experience activities in the molecular biosciences will be provided to increase both the numbers and quality of undergraduate biology students.

R&D budget authority for biological,
behavioral, and social sciences
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$265	$280	$313	11.7%
Biotic systems and resources	59	63	76	20.8
Cellular biosciences	54	56	61	9.0
Molecular biosciences	45	47	51	10.3
Behavioral and neural sciences	44	45	48	7.8
Instrumentation and resources	34	37	40	9.3
Social and economic sciences	30	31	33	7.4
Science and technology centers	-	3	4	20.0

SOURCE: National Science Foundation, SRS

Behavioral and neural sciences: This program serves as the bridge between the biological and social sciences, advancing the understanding of the biological, environmental, and cultural factors that underlie the behavior of humans and animals. Programs include anthropology, neurosciences, the biological basis of behavior, and language, cognition, and social behavior. The most substantial growth in funding will support additional research on animal behavior related to biodiversity and research on the biological basis of behavior, including the neurobiology of learning and memory, and understanding hormonal influences on the central nervous system. Human resource needs will be addressed through additional support for students and researchers.

Instrumentation and resources: Increased support for advanced instrumentation and sophisticated techniques, and opportunities for advanced training will continue to be emphasized. The biological database initiative will be supported with funds for the establishment of a National Center for Biological Computing. Interdisciplinary research on the biological sciences' specialized needs in the areas of data input, organization, and manipulation also will be funded.

Social and economic sciences: Disciplinary and interdisciplinary research on human social behavior and social organizations and systems are supported. Funding emphasis will continue to shift from focus on the individual to the integrated study of individuals and organizations and institutions over time. New emphasis is being placed on research on social and economic contributions to global change. Support will continue for large-scale multi-user data resources for empirical research in the social and economic sciences and research on organizational efficiency, economic competitiveness, legal compliance, and political economy. Research experiences for undergraduates and support for graduate students also will be emphasized.

Engineering

The engineering directorate (ENG) seeks to develop the engineering science base, encourage technological innovation, promote cross-disciplinary research, improve the quality of engineering education, and provide additional opportunities for minorities, women, and the disabled. ENG also supports engineering centers located on university campuses.

The 1990 request for research funding for the ENG directorate is $211 million, a 13-percent increase over 1989. ENG receives 11 percent of NSF research funding. In 1990, particular disciplinary emphasis will be given to microscale chemical processing, small electromechanical and electronic devices, downstream biochemical processing, optical high-speed communications, the management of technology, and initiation of emerging engineering technologies. Engineering centers will continue to play a major role in NSF's engineering activities.

Biological and critical systems: The bioengineering and environmental systems programs support research to improve the ability to cope with threats to the physical environment and to explore basic engineering problems related to ocean resources. The hazard mitigation programs support research providing new engineering capabilities to understand, prepare for, and recover from natural disasters. A special research thrust in the downstream processing of bioproducts will begin in 1990. Other activities of particular note are research on non-invasive assessment of biological functions, intelligent control for systems to aid persons with physical or cognitive disabilities, and detection of impending failure of implanted devices. Research on ocean engineering and on systems to reduce damage to structures as a result of major earthquakes will continue to receive strong support.

Chemical and thermal systems: The development of an engineering base for technologies involving chemical, thermal, and flow processes important in areas such as microelectronics, specialty chemicals, pharmaceuticals, energy production, advanced materials, and the processing of hazardous waste are all supported by this program. Industry/university cooperative research is an important focus of chemical and thermal systems research activities. In 1990, support will be increased for research on microscale chemical processing. Additional funds will be devoted to research support for undergraduate programs and instrumentation and laboratory improvement.

R&D budget authority for engineering
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$172	$187	$211	12.8%
Biological and critical systems	34	37	40	9.0
Chemical and thermal systems	32	33	36	8.1
Electrical and communications systems	29	32	36	13.2
Mechanical and structural systems	24	25	27	8.5
Design and manufacturing systems	18	19	22	13.5
Engineering centers	36	42	51	21.9

SOURCE: National Science Foundation, SRS

Electrical and communications systems: Major support will be given to research on microelectromechanical engineering, tissue engineering, biosensors, high-speed optical and electronic interconnections, and materials and devices to realize fully integrated optoelectronic circuits on chips. Support will also increase for the Emerging Technologies Initiation Program which provides initial funding for technologies that are broadly applicable to new products and processes. Research on advanced laser applications, plasmas for material processing, and decision making approaches to resource allocation in complex activities will continue to be funded.

Mechanical and structural systems: Additional funding will be used to increase the number of investigator and group grants in high priority areas and to augment undergraduate programs. Research will be focused on micromechanics and failure mechanisms for material systems, development of intelligent machines which can adapt to changing requirements, interfacial behavior of new materials in contact, and the development of more sophisticated experimental techniques for structural analysis.

Design and manufacturing systems: This activity works to develop the scientific foundations of design, manufacturing, and computer-integrated engineering across a broad spectrum of American industry. The 1990 program will increase support for modeling and simulation of manufacturing processes, development of new processes for specially engineered materials, and design principles for the next generation of intelligent machine tools. Additional research will also be supported on the life cycle of engineering, design methodology, design for manufacturability, and engineering and technology management for the computer-integrated enterprise.

Engineering centers: Engineering research centers have a special emphasis on developing an improved understanding of the integration and management of engineering systems. Engineering centers focus on major technological areas including manufacturing and design, materials processing for manufacturing, optoelectonics, microelectronics, electrocommunications, biotechnology and bioengineering, resource recovery, resource utilization, and the environment. By the end of 1989 there will be 50 operational centers. Three new centers are proposed for 1990.

Computer and information science and engineering

The computer and information science and engineering directorate (CISE) supports research to improve fundamental understanding of computing and information processing, promotes human resource development to contribute to and exploit new knowledge, and supports the operation of advanced national facilities for supercomputing and computer networking.

The 1990 request for research funding for the CISE directorate is $173 million, a 26-percent increase over 1989. CISE receives 9 percent of NSF research funding. Opportunities for larger, group awards will be made available in several areas in 1990, including VLSI-based advanced computers and prototyping, telerobotics, computer vision, speech, and coordination technology, fundamentals of software engineering and systems, advanced scientific networking applications, and advanced network and network security. Efforts to increase the human resource base in computer science remain a high priority.

Advanced scientific computing: Five national supercomputing research centers and basic research on methods and technologies for high performance scientific computing continue to receive support. Beginning in 1990, the centers will be used as testing grounds to incorporate new high performance computer architectures and peripherals into advanced research. Efforts to improve researchers' access to, and use of, advanced computer systems will also be increased.

R&D budget authority for computer and information science and engineering
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$112	$138	$173	25.6%
Advanced scientific computing	32	43	55	28.5
Networking and communications research and infrastructure	12	18	27	53.1
Computer and computational research	20	21	24	11.8
Information, robotics, and intelligent systems	18	19	22	13.1
Microelectronics information processing systems	13	15	19	26.7
Cross-disciplinary activities	17	17	21	23.0
Science and technology centers	-	5	5	14.9

SOURCE: National Science Foundation, SRS

Networking and communications research and infrastructure: This program supports the development and operation of a general purpose computer network for supercomputer access, and fundamental scientific and engineering research on communications theory and network design. NSFNET provides access to the NSF supercomputer centers for the national computational science community. The 1990 budget request extends NSFNET from about 240 to about 400 institutions and supports basic research on high speed networking, network management, advanced applications, data compression and coding, and network security.

Computer and computational research: Research on the laws which govern problem solving procedures and on the computing systems which test and utilize these procedures will continue to receive support. The request for 1990 increases the emphasis on research on parallel computing systems, software, and architecture, utilization of new architectures, the improvement of algorithms for scientific computing, and the integration of numerical and symbolic techniques.

Information, robotics, and intelligent systems: Research on the design of information systems and their effect on social and economic functions is conducted in this program area. Support will be expanded for two initiatives begun in 1989: coordination theory and technology, and artificial intelligence.

Microelectronics information processing systems: A major goal of this program is to produce the knowledge and mechanisms necessary for the economical and simplified creation of special purpose information processing and computing devices. Areas to receive increased funding include microelectronic design, experimental work on new types of VLSI-based advanced computers, rapid prototyping of experimental systems, and hardware and software tools for VLSI circuit design and software systems.

Cross-disciplinary activities: The request for 1990 substantially increases a variety of educational infrastructure and human resource building programs. Particularly noteworthy is the expansion of support for activities at minority institutions.

U.S. Antarctic Program

The U.S. Antarctic Program works to protect the ecological viability of the continent, foster cooperative research, and ensure the equitable and wise use of the region's resources. The program supports research on topics that contribute directly to the NSF Global Geosciences Program.

The 1990 funding request for research activities in the Antarctic Program is $136 million, a 15-percent increase over 1989. The Antarctic program receives 7 percent of NSF research funding. A major multi-year safety, environment, and health initiative is proposed to begin in 1990.

Operations support: Conduct of research in the Antarctic involves costs above what would be required merely to maintain a U.S. presence in the region. This includes operation of research ships, aircraft, and land-based research stations. A second research ship with ice-breaking capacity will be acquired by lease and added to operations in 1990.

Major construction and procurement: Projects related to the safety, environment, and health initiative will include improved field party communications, search and rescue communications, and the design of a waste water treatment system. Work on a science laboratory at McMurdo Station will continue.

U.S. Antarctic research program: Research across the disciplines applicable to Antarctica will be continued with some changes in emphasis. Increased funding will provide for a long-term ecological research project, initiation of a large-scale geophysics program, and continued expansion of astronomy and astrophysics research. Seasonal depletion of ozone over the Antarctic and ecological interactions in the Antarctic will continue to be major areas of concern.

R&D budget authority for U.S. Antarctic program
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$113	$118	$136	15.1%
Operations support program	85	87	102	16.9
Major construction and procurement	14	15	16	6.6
U.S. Antarctic research program	14	16	18	12.9

SOURCE: National Science Foundation, SRS

Scientific, technological, and international affairs

The scientific, technological, and international affairs directorate (STIA) is responsible for a wide variety of special NSF activities related to science and engineering research and education. Education and human resource development receive major emphasis under STIA programs.

The 1990 request for research funding for STIA is $61 million, a 14-percent increase over 1989. STIA receives 3 percent of NSF research funding.

Research initiation and improvement: Funding is directed toward increasing research opportunities for minority, women, and disabled investigators, improving access to research resources, and understanding the human and institutional resources that contribute to a strong science and technology base.

Industrial science and technological innovation: This program has primary responsibility for the small business innovation research program. In 1989, 217 awards will be made to firms working in critical technology areas. It is expected that 1,500 proposals will be submitted for consideration in 1990.

International cooperative scientific activities: Support for international cooperative programs that substantially benefit U.S. science and engineering is the focus of this program. Increased emphasis will be placed on promoting access to Japanese academic, industrial, and government laboratories, implementing new initiatives with key Pacific Rim countries, and increasing international research experiences for undergraduates.

R&D budget authority for scientific, technological,
and international affairs
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$46	$54	$61	13.6%
Research intitiation and improvement	17	23	27	15.7
Industrial science and technological innovation	17	19	22	13.8
International cooperative scientific activities	11	11	12	8.8
Policy research and analysis	(a)	(a)	(a)	0.0
Science resources studies	(a)	(a)	(a)	30.0

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Department of Energy

DOE's general science programs support basic research in areas that are expected to have long-term impact on energy development and utilization. Research on high energy physics and nuclear physics is supported through direct funding of individual projects and for research-related activities at numerous user facilities.

Funding for DOE's general science programs is proposed to increase by 8 percent, to $771 million, in 1990. All of this funding is used in support of basic research, primarily at the national physics laboratories.

High energy physics

In 1990, highest priority will be given to strong research programs and supporting facilities operation at the new electron-positron collider at the Stanford Linear Accelerator Center and the Tevatron proton-antiproton collider at Brookhaven National Laboratory. Additional funding will be provided to restore the operational effectiveness and technical capabilities of university research groups and to support experimental groups at the new facilities. Specific projects include continued theoretical and

R&D budget authority for the general science programs
of the Department of Energy
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$628	$715	$771	7.8%
High energy physics	408	439	493	12.2
Facility operations	230	252	278	10.0
Physics research	114	122	133	9.3
High energy technology	64	65	82	26.0
Nuclear physics	184	190	205	8.1
Medium energy nuclear physics	84	86	94	9.3
Heavy ion nuclear physics	65	68	72	5.9
Low energy nuclear physics	25	26	27	5.8
Nuclear theory	11	11	13	17.6
Superconducting Super Collider	33	83	69	-16.5
General science program direction	3	3	4	21.9

SOURCE: National Science Foundation, SRS

high energy astrophysics research and the first physics checkout run of the new D-Zero detector facility at Fermilab. At the Stanford Linear Accelerator Center, the research groups will continue to study Z-zero particles with the Mark II detector as well as conduct experiments that take advantage of continued luminosity improvements. Researchers at Brookhaven National Laboratories will continue with their significant emphasis on rare kaon decay experiments. Theoretical studies of accelerator physics, exploration of new concepts for particle acceleration, storage, and transport, and new types of detectors will be funded by the high energy technology program.

Nuclear Physics

The nuclear physics program conducts basic research and tests theoretical predictions on the structure and interaction of atomic nuclei and the fundamental forces and particles of nature as they manifest themselves in nuclear matter. Over 75 percent of the scientists supported by the program plan experiments and conduct research at large user-dedicated laboratories. These facilities include the Bevalac at Lawrence Berkeley Laboratory, the Tandem/AGS high energy heavy ion beams at Brookhaven National Laboratory, the Los Alamos Meson Physics Facility, the Continuous Electron Beam Accelerator Facility, and the ATLAS superconducting heavy ion facility at Argonne National Laboratory. Increased research support will be given to students and postdoctoral fellows to accommodate growing interest in nuclear physics and to enhance theoretical work. The medium energy nuclear physics program supports research on scattering of pions and protons, weak interactions, muonic and pionic atoms, selective excitation of proton/neutron states, and giant resonances. The heavy ion research program supports studies of the behavior of nuclear matter over an increasing range of excitation energy, nuclear density, angular momentum, and deformation. The low energy nuclear physics program emphasizes experimental investigations of nuclear structure, nuclear decay parameters and low energy reaction mechanisms. The nuclear theory program interprets results from experiments and predicts phenomena and relationships in order to develop a comprehensive understanding of the foundations of nuclear matter at the most fundamental level.

Super Conducting Supercollider

The Super Conducting Supercollider (SSC) is a high luminosity proton-proton collider having an energy of 20 trillion electron volts (Tev) per beam. It will permit the exploration of the Tev mass region that is essential to enable the U.S. high energy physics research program to remain at the frontier. As the SSC project moves from research and planning into construction in 1990, research and development funding will decline. The continuing research program will have a strong focus on the long superconducting dipole magnets, extensive design, prototyping and testing of other collider technical systems, and a major program of work on specific detectors.

ENERGY

Three agencies provide support for R&D efforts in this function: the Department of Energy, the Nuclear Regulatory Commission (NRC), and the Environmental Protection Agency (EPA).

Energy R&D activities in 1990 primarily emphasize long-term, high risk efforts which support a mix of technologies aimed at expanding domestic energy supplies, achieving greater efficiency in energy use, improving knowledge on the fundamentals of matter and energy, understanding the health and environmental consequences of energy technologies, supporting nuclear regulation by providing technical bases for regulatory action to ensure public health and safety, and generating information to guide the development and use of energy resources in an environmentally acceptable manner.

Proposed budget authority for energy R&D activities will drop 4 percent to $2.3 billion in 1990. This is attributable to a combination of reductions with some offsetting increases in the R&D activities of the Department of Energy and the Environmental Protection Agency, including the following scheduled changes.

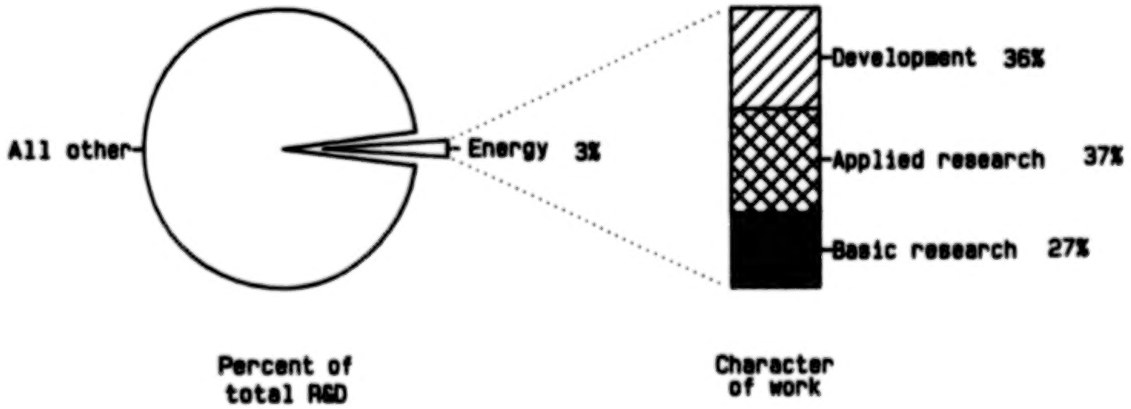
- An overall decrease of $63 million is expected for fossil energy, with large reductions proposed for coal, petroleum, and gas and offset by significant increases scheduled for clean coal R&D activities.
- A decrease of $50 million is proposed for R&D programs on energy conservation.
- A $35 million decline is expected for the R&D activities of solar and other renewable energy programs.
- A decrease of $17 million is scheduled for the R&D programs of the Environmental Protection Agency.
- An increase of $34 million is proposed for supporting research and technical analysis.
- A $30 million increase is planned for biological and environmental research.

R&D budget authority for energy
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$2,126	$2,427	$2,333	-3.9%
Department of Energy	1,967	2,261	2,170	-4.0
Supporting research and technical analysis	438	462	496	7.4
Fossil energy	356	549	486	-11.5
Magnetic fusion	296	317	308	-2.7
Nuclear fission	321	305	296	-3.0
Biological and environmental research	202	225	255	13.5
Uranium enrichment	73	119	137	15.4
Solar and other renewable energy	145	145	110	-24.1
Energy conservation	137	140	83	-40.9
Nuclear Regulatory Commission	104	111	124	11.6
Environmental Protection Agency	55	55	38	-30.4

SOURCE: National Science Foundation, SRS

R&D budget authority for energy: 1990



SOURCE: National Science Foundation, SRS

Supporting research and technical analysis

In 1990, an increase of $34 million to $496 million is scheduled for supporting research and technical analysis. These programs focus on areas of fundamental science that have the greatest potential impact on energy production; the assessments of energy-related technologies that have potentially high payoffs in the future; and the training of professionals in energy-related activities. The principal program is basic energy sciences which accounts for 95 percent of funding in supporting research and technical analysis.

The basic energy sciences program will increase by $40 million to $471 million in 1990. This program is responsible for generic long-term research in nuclear and non-nuclear energy technologies. This program focuses on the development of new technologies and improvements to existing technologies. The majority of funding is directed toward the traditional scientific disciplines. All of the R&D activities within this program are scheduled to increase in 1990. Research in materials, particularly high-temperature superconductors, is receiving increased emphasis, as is research in chemical sciences.

R&D budget authority for supporting research and technical analysis
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$438	$462	$496	7.4%
Basic energy sciences	411	430	471	9.4
Materials sciences	170	181	202	12.1
Chemical sciences	127	133	148	11.3
Applied mathematical sciences	42	43	45	5.2
Engineering and geosciences	31	33	34	2.7
Energy biosciences	20	21	21	2.9
Advanced energy projects	14	15	15	2.8
Program direction	5	5	6	12.2
University research support	18	22	16	-25.8
University research instrumentation	5	5	5	0.0
Energy research analysis	4	4	4	5.3

SOURCE: National Science Foundation, SRS

University research support will decrease 26 percent to $16 million in 1990 and University research instrumentation is scheduled to remain unchanged at $5 million. These two programs are the primary mechanisms used by DOE to strengthen the institutional capabilities of universities and colleges as the agency's contribution to long-range R&D efforts. Energy research analysis is proposed to increase 5 percent to $4 million in 1990. This program provides the capability for undertaking independent technical assessments of DOE research programs. This program helps determine priority needs and provides the resources for the development of independent views on the overall direction of future R&D efforts.

Fossil energy

The 1990 R&D budget authority request of $486 million for fossil energy is $63 million less than the 1989 level. The fossil energy program focuses on establishing an adequate scientific and engineering knowledge base to assist private sector efforts in developing and applying new technologies for recovering and producing fossil and synthetic fuels.

The clean coal technology program is a government/industry co-funded effort to demonstrate advanced concepts for using coal cleanly and more efficiently. The program was begun and expanded in response to a proposal by the U.S. and Canadian Special Envoys on acid rain. Two rounds of competition have been completed and 29 projects estimated at a total budget cost of $2.3 billion have been selected. Nine projects have completed negotiation and are currently underway to retrofit, repower, and modernize existing coal burning facilities. The initial 1990 estimate of R&D funding for this program was $325 million. It is anticipated that revised R&D funding for clean coal technology will increase significantly beyond the initial 1990 budget level.

R&D funding for the coal program is expected to drop by $136 million to $106 million in 1990. Reduced funding levels are proposed for all subprograms, except for the magnetohydrodynamics program, which is scheduled for termination in 1990. Despite the reductions, the coal program will continue to conduct generic crosscutting research with a major thrust in technologies related to acid rain.

The petroleum R&D program in 1990 is proposed for a $14 million reduction. Enhanced oil recovery and oil shale activities are scheduled for decreased funding. This program supports research which could lead to improved technologies for the exploration, development and production of petroleum resources. Funding in 1990 includes an emphasis on the geosciences research program to better understand reservoir characteristics and recovery processes.

R&D budget authority for unconventional gas recovery is expected to drop $7 million to $4 million in 1990. The goal of this program is to assist the private sector in developing cost-effective diagnostic and extraction technologies to produce gas efficiently and economically from unconventional gas resources. The 1990 budget request proposes a decrease in all gas R&D programs with the largest reduction in funding for Western tight sands experiments.

R&D budget authority for fossil energy
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$356	$549	$486	-11.5%
Clean coal technology	50	190	325	71.1
Coal	208	242	106	-56.0
Control technology and coal preparation	44	49	32	-35.4
Advanced research and technology	25	26	26	-0.4
Combustion systems	20	27	16	-40.8
Coal liquefation	27	32	10	-70.1
Heat engines	18	23	9	-62.7
Fuel cells	21	26	7	-74.9
Surface coal gasification	16	22	9	-60.6
Underground coal gasification	2	1	(a)	-78.6
Magnetohydrodynamics	35	37	-	*
Petroleum	29	38	25	-36.0
Enhanced oil recovery	16	24	18	-22.9
Advance extraction & process technology	3	4	5	9.5
Oil shale	10	11	2	-83.8
Gas--unconventional gas recovery	11	11	4	-64.0
Program direction and management support	59	67	26	-61.8

* Proposed for elimination.

SOURCE: National Science Foundation, SRS

Magnetic fusion

R&D budget authority for magnetic fusion will show a decrease of $9 million, to $308 million in 1990, and is primarily attributable to reductions in both the confinement systems and the applied plasma physics program. The long-term need for magnetic fusion as an energy supply system remains strong because it is a source that is secure and environmentally acceptable.

The 1990 budget request for magnetic fusion supports the development of fusion power as a future energy option and provides funding for the support of initiatives including international cooperation. Research efforts will continue for the Compact Ignition Tokamak, and the International Thermonuclear Experimental Reactor, an international engineering fusion test reactor.

R&D budget authority for magnetic fusion
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$296	$317	$308	-2.7%
Confinement systems	160	175	168	-3.8
Toroidal confinement systems	156	172	165	-4.0
Mirror confinement systems	4	3	3	7.1
Applied plasma physics	75	78	73	-6.4
Experimental plasma research	16	18	24	29.1
Fusion plasma theory	19	20	21	7.1
National MFE computer network	18	18	16	-13.2
Advanced fusion concepts	22	22	13	-41.4
Development and technology	56	54	57	4.8
Fusion technologies	22	24	22	-9.1
Plasma technologies	23	19	21	10.9
Fusion systems analysis	11	11	14	23.9
Planning and projects	1	5	5	-2.0
Program direction	5	5	5	8.7

SOURCE: National Science Foundation, SRS

Confinement systems, the largest program within magnetic fusion, is expected to fall to $168 million. This decrease is completely attributable to a drop in support expected for toroidal confinement systems, which is one of the two base types of magnetic fusion currently being pursued. The second base technology is mirror confinement, which is slated for a proposed increase to $3 million in 1990.

The applied plasma physics program is scheduled to decrease $5 million, to $73 million. These funds will be used to provide for a strong base of plasma research, as well as advances in fusion plasma theory.

The development and technology program is proposed at $57 million in 1990. The growth in funding reflects increases for plasma technologies and fusion systems analysis.

Nuclear fission

The goals of the nuclear energy R&D program are: the establishment of a predictable regulatory and institutional environment that enables nuclear power to compete freely in the marketplace; the support of industry efforts to revitalize the light-water reaction option in the United States; the exploration of the feasibility of advanced nuclear reactor systems; the support of international nuclear R&D projects; the strengthening of the U.S position in international commerce; meeting long-term needs on uranium enrichment; and conducting development programs on compact space and terrestrial nuclear power systems.

Nuclear energy R&D is expected to decrease $9 million to $296 million. Reduced funding is proposed for advanced reactor R&D, space and defense power systems, and light water reactors. The decline in these programs is partially offset by large increases in test facilities and advanced nuclear systems.

The test facilities program is expected to receive a $41 million increase to $165 million. This program provides safe, reliable, and economical testing capabilities for the development of nuclear power systems for space, defense, and civilian applications. Emphasis will be on R&D efforts to improve safety and productivity.

Advanced nuclear systems funding is expected to increase to $40 million. This program develops and maintains the national capability to produce radioisotopic power sources for civilian and military applications jointly with other government agencies. The growth in funding for 1990 is expected to emphasize additional support for the Turbine Energy Conversion System program.

The advanced reactor R&D program is expected to drop significantly from $75 million to $31 million. This program supports the development of highly innovative reactor systems with the potential for breakthroughs in economics, safety, licensability, and waste management. Support will continue for the modular high-temperature reactor and liquid-metal reactor concepts. Funding in 1990 will decrease reflecting an emphasis on government/private sector cost sharing initiatives.

The space and defense power systems program includes a tri-agency effort by DOE, NASA, and DOD to develop a safe, durable, light-weight, and high-performance reactor which will serve civilian and military missions.

The light water reactors R&D effort supports industry-led efforts to revitalize light water technology as a vital component of the national energy base to meet electricity demands.

R&D budget authority for nuclear fission
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$321	$305	$296	-3.0%
Nuclear Energy R&D	316	305	296	-2.9
Test facilities R&D	118	124	165	33.3
Advanced nuclear systems	26	32	40	25.6
Advanced reactor R&D	75	75	31	-59.0
Space and defense power systems	57	39	27	-30.1
Light water reactors	32	27	24	-10.4
Program direction	9	9	9	3.5
Remedial action and waste technology	5	1	-	*

* Proposed for elimination.

SOURCE: National Science Foundation, SRS

Biological and environmental research

Biological and environmental research is expected to increase $30 million to $255 million in 1990. This program represents the Nation's only long-term research effort specifically focused on energy-related health and environmental issues. These R&D efforts seek to identify, understand, and anticipate the long-term health and environmental consequences of energy development and use; and to employ DOE's scientific and technological capabilities to solve major scientific problems in medicine and biology.

Funding in 1990 will emphasize research on developing technologies for mapping the entire human genome and on enhancing research efforts to reduce uncertainties concerning the effects of increased carbon dioxide in the atmosphere. Research will also focus on understanding the movement and degradation of radioactive and chemical mixtures below the earth's surface and on reducing the cost and time for waste cleanup activities.

Health effects activities are scheduled for an increase in 1990 to $72 million. This research activity develops a broad and scientifically sound data base for evaluating the potential adverse health effects that could result from exposures to radiation and chemical agents most relevant to DOE programs.

In 1990, general life sciences research will receive increased emphasis and funding will rise from $46 million to $60 million. This activity contributes to the base of fundamental biological knowledge that is required for the effective study and interpretation of energy-related health effects. The human genome program, the largest activity within general life sciences research, is expected to increase 58 percent to $28 million.

R&D budget authority for biological and environmental research
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$202	$225	$255	13.5%
Health effects	66	69	72	4.2
General life sciences	38	46	60	31.0
Environmental	31	37	44	19.1
Medical applications	34	37	38	2.7
Carbon dioxide research	14	18	21	18.2
Analytical technologies	15	15	16	9.5
Program direction	4	4	5	15.0

SOURCE: National Science Foundation, SRS

Activities under environmental research are scheduled to grow to $44 million. This activity addresses the transport of discharges and their behavior through the atmosphere at different spatial scales and over different time sequences. Increased research focus will be on the exposure of these materials to the environment and the resiliency of biological systems to disturbance.

Uranium enrichment

Uranium enrichment is scheduled for an $18 million increase in funding to $137 million in 1990. The goal of this program is to conduct research in support of the U.S. Government requirements to meet domestic and foreign uranium enrichment services in the most economical, reliable, safe, secure, and environmentally acceptable manner possible. Uranium enrichment R&D activities are all conducted under the Atomic Vapor Laser Isotope Separation (AVLIS) program. A main objective of this program is to assure long-term price competitiveness of the United States by having an advanced technology option available to all interested institutions that can enrich uranium at a cost significantly less than gaseous diffusion plants and foreign competitors. A long-term goal is to transfer the uranium enrichment enterprise to the private sector.

R&D budget authority for uranium enrichment
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$73	$119	$137	15.4%
Atomic Vapor Laser Isotope Separation	73	119	137	15.4
Lasers	29	44	50	13.0
Uranium separators	29	43	50	15.4
Systems integration technology	9	19	20	2.6
Process development and deployment planning	3	5	8	71.4
Uranium processing	3	7	8	8.7
Technology transfer and analysis	1	1	3	127.3

SOURCE: National Science Foundation, SRS

In 1990, a significant expansion of activities is proposed to support major multi-year efforts and to support development associated with an early 1990's demonstration program. Funding for the lasers program will increase to $50 million. Major R&D efforts include the continued operation of two copper laser corridors. An additional $7 million is proposed for the R&D activities of the uranium separators program related to the development of a demonstration-scale uranium metal handling facility and the procurement and installation of additional copper vapor lasers. The uranium processing program will receive increased funding to complete the development of a prototype electrolytic reduction cell and to complete modifications for a product conversion facility.

Solar and other renewable energy

R&D budget authority for solar and other renewable energy is expected to decrease $35 million to $110 million in 1990. This functional activity is comprised of the following three programs: solar energy, electric energy and energy storage systems, and geothermal energy.

The solar energy R&D program is designed to support generic and long-range research on a variety of alternative energy technologies that offer a diversification of supply that can satisfy energy demands in all common forms used throughout the economy. All major activities will receive reduced funding or remain unchanged in 1990. The main research areas being pursued at universities and national laboratories are materials sciences, biotechnology, engineering systems, and thermodynamic cycles. Photovoltaic energy systems, which is the largest solar energy program, will receive $25 million in 1990. This program supports research that involves the direct conversion of sunlight into electricity. Solar thermal energy systems will receive a $2 million reduction in 1990, to $13 million. The objective of solar thermal energy systems is to advance the engineering and scientific base from which private industry can develop solar thermal power production options. Biofuels energy systems research funding emphasizes improved methods of growing and converting renewable organic materials into directly usable liquid and gaseous fuels. Wind energy systems research will focus on understanding the sources of wind variability, interaction between wind input and wind turbines, and the use of advanced components for improved performance.

R&D budget authority for electric energy systems and energy storage systems is scheduled to decrease $11 million in 1990. These programs direct research toward solving electric energy transmission and distribution problems and on increasing the efficiency of the energy economy. Emphasis in 1990 is on the electromagnetic pulse effect and the introduction of new materials, including superconducting materials, for increasing the efficiency of electric power transmission. Each component of this program is expected to receive less funding than in 1989.

Geothermal energy R&D programs are expected to receive a decrease of $4 million to $15 million in 1990. The objective of this program is to assist the private sector in developing a technology base that will be used for future commercial geothermal development. All activities within the geothermal energy program are expected either to receive reduced funding or to remain unchanged. Geopressured research is scheduled for a 52-percent reduction to $3 million and funding for reservoir technology is expected to decrease to $2 million.

R&D budget authority for solar and other renewable energy
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$145	$145	$110	-24.1%
Solar	95	90	69	-22.8
Photovoltaic energy systems	35	35	25	-28.8
Solar thermal energy systems	17	15	13	-10.2
Biofuels energy systems	17	13	9	-34.1
Wind energy systems	8	8	8	-1.2
Solar building energy systems	5	5	4	-24.1
Ocean energy systems	4	4	2	-48.8
Solar technology transfer	3	2	2	-25.0
Resource assessment	1	1	1	14.3
International solar energy	1	1	1	-40.0
Program direction and support	5	5	5	0.0
Electric energy and energy storage systems	29	37	26	-29.4
Electric energy systems	15	23	17	-27.6
Energy storage systems	14	13	8	-37.4
Program direction	(a)	(a)	(a)	0.0
Geothermal	21	19	15	-19.8
Hot dry rock research	6	4	4	0.0
Geopressured research	5	6	3	-51.7
Hard rock penetration research	2	2	2	0.0
Reservoir technology	4	3	2	-12.0
Magma energy	1	2	2	0.0
Conversion technology	2	2	2	-15.8
Hydrothermal industrialization	1	-	-	*
Program direction	1	1	1	0.0

* Scheduled for elimination.

SOURCE: National Science Foundation, SRS

Energy conservation

Energy conservation is scheduled for a reduction of $57 million to $83 million in 1990. This program supports research in areas of energy conservation where new knowledge can expand the technology base which will assist the private sector in developing technological means to use energy economically. The program supports activities ranging from basic research in universities and national laboratories to applied research and development in industrial firms.

Transportation R&D funding for energy conservation is proposed at $29 million. All of the major transportation programs in energy conservation will decrease in 1990. The electric-hybrid vehicle R&D program is expected to experience the largest decline. The vehicle propulsion R&D program and the advanced materials development program will also suffer severe cutbacks in 1990. The remaining programs in transportation focus on research efforts to improve the energy efficiency of vehicle systems with increased emphasis on advanced ceramics.

The 1990 budget authority reflects a reduced request of $19 million for multisector R&D programs. The multisector program supports basic research and exploratory development of new concepts that offer increased efficiencies in energy conversion and utilization applications. Funding for the energy conversion and utilization technologies (ECUT) program is scheduled to decrease in 1990 and emphasis will be devoted to the thermal sciences, the material sciences, biocatalysis, and tribology.

R&D budget authority for energy conservation
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$137	$140	$83	-40.9%
Transportation	48	52	29	-44.0
Multisector	24	26	19	-27.3
Industrial	31	27	16	-41.2
Buildings and community systems	34	32	16	-49.7
Policy and management	2	3	3	-3.7

SOURCE: National Science Foundation, SRS

Industrial R&D programs are scheduled to decrease by $11 million to $16 million in 1990. These programs support research and development activities that have the potential to increase energy use efficiency and the use of alternative fuels in private industry. This decline results from reductions in all R&D activities including the industrial process efficiency program and the waste energy reduction program. Funding will be cut back to $5 million in 1990 for each program. The industrial cogeneration program is scheduled to drop to $2 million.

R&D funding for buildings and community systems will be cut in half to $16 million in 1990. All activities within this program, except for the Federal energy management program, are scheduled for reductions in 1990. The program supports the development of more efficient building equipment and supplies, and the optimal use of energy in buildings. The technology and consumer products area, building systems research, and community systems programs are all scheduled for sharp reductions in 1990.

Nuclear Regulatory Commission

The proposed 1990 request for NRC is $124 million, or $13 million more than in 1989. The Office of Nuclear Regulatory Research has the authority and the responsibility under the Energy Reorganization Act of 1974 to conduct research in support of the nuclear regulatory process. Nuclear safety research has three main purposes: (1) to provide independent expertise and information for making accurate and timely regulatory judgments; (2) to anticipate problems of safety significance so that new knowledge can assist the NRC in pursuing its mission; and (3) to develop regulations and guidelines necessary to implement policy or technical requirements.

Reactor containment and public protection funding is expected to increase to $33 million in 1990. This program is primarily directed toward protecting the public in the unlikely event of a very severe reactor accident. These R&D activities include the siting of nuclear plants away from population centers, the inclusion of specially engineered safety systems designed to prevent failure of the containment structure, and development of safety systems to limit the quantities of fission products that might be released if the containment structure were to lose its leak-tight integrity. Major subprograms include: core melt and reactor coolant system failure, reactor containment safety, reactor containment structural integrity, severe accident policy, and radiation protection and health effects. Increased funding in 1990 is for research on severe accident phenomena and to review additional risk studies.

Integrity of reactor components funding is expected to increase to $32 million in 1990. This program examines reactor systems and related components to determine whether they perform as designed and ensures that the functional integrity and operability of the systems can be maintained over the life of the plant. This program consists of four major activities: reactor vessel and piping integrity, aging of reactor components, reactor equipment qualification, and seismic and fire protection. The increase in 1990 funding is for pressure vessel safety irradiation tests and studies associated with pipe cracking, and for the evaluation of inservice inspection performance and degradation mechanisms of failed electrical and mechanical components.

Research on preventing damage to reactor cores is expected to increase to $25 million. This program encompasses the operations of the reactor as a system, including control of power level, maintaining coolant in the reactor system, core cooling and heat removal, and maintaining proper temperatures and pressures. Major subprograms are: plant performance, human performance, accident management, and the reliability of reactor systems. Individual activities contributing to this increased funding are: establishing the applicability of thermal hydraulics codes for use in the review of light-water reactor designs; research in human factors; improving the reliability of reactor systems; and accident management research for guidance in evaluating industry programs.

The resolving safety issues program ensures that resources are directed toward the development of technical and regulatory requirements to protect the health and safety of the public from the generation of electricity and in the manufacturing, processing, transporting, and storing of nuclear fuel. Major subprograms are: generic and unresolved safety issues, standardized and advanced reactors, fuel cycle, materials, safeguards, transportation, and developing and improving regulations.

R&D budget authority for the Nuclear Regulatory Commission
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$104	$111	$124	11.6%
Reactor containment and public protection	30	29	33	14.7
Integrity of reactor components	26	30	32	8.4
Preventing damage to reactor cores	19	21	25	19.4
Resolving safety issues	8	11	11	4.6
Confirming safety of waste disposal	2	2	2	15.8
Administrative and staff support	19	19	21	7.2

SOURCE: National Science Foundation, SRS

Environmental Protection Agency

Energy-related R&D activities within EPA are expected to decrease $17 million to $38 million. All energy R&D activities are performed under the multi-media energy research program. The largest activity, acid rain, is expected to absorb all of the decline in funding for this program. The reduction reflects completion of aquatic effects research projects, some terrestrial effects research projects, and emission projection models. Research activities in environmental engineering and technology are expected to remain unchanged, with R&D efforts continuing in the Limestone Injection Multistage Burner (LIMB) control technology commercial demonstration program.

R&D budget authority for the energy R&D program of
the Environmental Protection Agency
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$55	$55	$38	-30.4%
Multi-media energy	55	55	38	-30.4
Acid rain	52	51	35	-32.5
Environmental engineering & technology	4	4	4	0.0

SOURCE: National Science Foundation, SRS

NATURAL RESOURCES AND ENVIRONMENT

R&D activities within this function are conducted by a number of Federal agencies including the Department of the Interior, the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, the U.S. Forest Service of the Department of Agriculture, and the Army Corps of Engineers. Research and development activities that fall within this function are viewed as contributing toward the management of public lands and other natural resources for their preservation, conservation, and economic development, as well as encouraging increased knowledge and understanding of the environment.

The proposed R&D budget authority for natural resources and the environment is $1.1 billion in 1990, compared to $1.2 billion in 1989. The 6-percent decline is attributable to a $121 million decrease proposed for R&D programs classified under other natural resources, resulting from the following reductions or eliminations.

- A 32-percent, or $88 million, reduction in support is proposed for R&D programs conducted by NOAA. This decrease results from a reduction of support for R&D programs of the National Marine Fisheries Service and the National Weather Service.

- A $24 million, or 25-percent, decline is scheduled for the R&D programs of the Bureau of Mines. These programs are expected to fall from $96 million in 1989 to $72 million in 1990.

- A 4-percent, or $8 million, reduction in 1990 R&D funding is requested for the U.S. Geological Survey, to a total of $232 million.

Elements of proposed R&D funding increases that will partially offset decreased program levels for 1990 include the following efforts.

- An increase of $51 million, or 15 percent, will raise the pollution control and abatement programs of the Environmental Protection Agency to $383 million.

- A 7-percent, or $3 million, growth in support for water resources to $41 million is largely related to increased funding levels for the Bureau of Reclamation (Interior) and the Army Corps of Engineers (DOD).

R&D budget authority for natural resources and environment
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$1,160	$1,208	$1,140	-5.7%
Pollution control and abatement				
Environmental Protection Agency	300	332	383	15.4
Conservation and land management	141	143	149	3.8
Forest Service (USDA)	136	138	143	3.8
Department of Interior	6	6	6	1.8
Recreational resources	78	81	74	-8.6
Fish and Wildlife Service (Interior)	59	62	55	-12.1
National Park Service (Interior)	19	19	20	2.6
Water resources	38	38	41	7.1
Corps of Engineers (DOD)	33	35	36	4.9
Bureau of Reclamation (Interior)	5	4	5	28.6
Other natural resources	603	614	493	-19.7
Geological Survey (Interior)	236	240	232	-3.5
National Oceanic and Atmospheric Administration (Commerce)	275	278	189	-31.8
Bureau of Mines (Interior)	92	96	72	-24.8

SOURCE: National Science Foundation, SRS

Pollution control and abatement

The 1990 budget includes $383 million for the pollution control and abatement programs of the Environmental Protection Agency. A growth of $51 million over the 1989 level is primarily for funding of interdisciplinary and air quality research. The goals of the research program at EPA are to develop the scientific data necessary for determining the most cost effective and environmentally safe means of achieving results, to provide the necessary scientific data in support of the statutory and regulatory responsibilities, and to further the state of knowledge on environmental problems not yet fully understood.

Major emphases in the 1990 budget include: enhancement of research on global climate change. strengthening the agency's long-term research capabilities, rebuilding the scientific infrastructure, and supporting media program needs.

Air quality: Research efforts are scheduled to increase to $84 million in 1990. These activities will support a significant expansion in stratospheric ozone depletion research, an analysis of the effects of global climate change, and an assessment of the environmental risks of indoor air pollutants. Research efforts will also support revisions to the National Ambient Air Quality Standards and the air toxics program.

Interdisciplinary: Research funding is expected to increase by $38 million to $78 million in 1990. This subactivity consists of programs that cut across all other R&D activities. They include uniform risk assessment, technical information and liaison, quality assurance management, exploratory research, reduction of uncertainties in risk assessment, human exposure, basic ecological research, and capital investments.

Superfund and LUST trust fund: Research activities in these programs are both expected to decrease in 1990. The Superfund research and development program provides a core of scientific and technical information to support efforts under the Superfund legislation. The research program concentrates on assessing the health and environmental risks posed by Superfund sites and on evaluating the equipment and techniques for discovering, assessing, preventing, removing, and disposing of hazardous substances released into the environment. The Leaking Underground Storage Tanks (LUST) Program provides technical assistance to the EPA's Office of Underground Storage Tanks and will focus on developing low-cost approaches for assessing site contamination and evaluating remedial technologies.

Hazardous waste: This program identifies and manages wastes that pose the threat of substantial harm to human health or the environment. The program also develops information for the issuance of standards related to underground storage systems for chemical and petroleum products.

Toxic substances: R&D efforts will continue to provide scientific tools and supporting information needed to implement the Toxic Substances Control Act (TSCA), the Asbestos Hazard Emergency Response Act (AHERA), and the Superfund Amendment and Reauthorization Act (SARA).

Water quality: Research funding will continue to support the mandates of the 1987 Clean Water Act Amendments and the Marine Protection, Research and Sanctuaries Act and includes the gathering of scientific data to help States develop water quality standards. Research is also conducted on evaluating impacts of ocean disposal practices, understanding the Great Lakes ecosystems, and developing responsive and scientifically valid estuarine programs. The program in 1990 will focus on the development of scientific data to implement regulations and provide guidance for sludge disposal and to enhance municipal water treatment plant regulations.

R&D budget authority for pollution control and abatement
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$300	$332	$383	15.4%
Environmental Protection Agency				
Air quality	66	69	84	21.9
Interdisciplinary	28	39	78	97.2
Superfund/Lust trust fund	63	74	69	-6.5
Hazardous waste	44	45	42	-6.8
Toxic substances	26	28	28	0.0
Water quality	24	24	26	8.7
Drinking water	22	22	23	8.4
Pesticides	13	14	14	5.9
Radiation	3	4	4	16.7
Program management and lab support	11	13	14	3.8

SOURCE: National Science Foundation, SRS

Drinking water: Research activities within this program provide health assessment information for two purposes. One is to support the development of new regulations to control drinking water contaminants. The second is to assist States in ascertaining the causes of waterborne infectious disease outbreaks in order to determine the hazard to humans from exposure to these diseases through drinking water. Emphasis in 1990 will be on identifying the processes by which certain chemical solvents and biological transformations facilitate the transport of subsurface water. In addition, efforts will be undertaken to identify and characterize the health impact of disinfectants and their by-products.

Pesticides: Research funding is scheduled to increase in 1990. Federal laws require the regulation of pesticide use to avoid unreasonable adverse effects to public health and the environment. Research activities will focus on understanding how pesticides interact with human activities and the environment and on determining the health and environmental effects of genetically-engineered pesticides. This will include developing methods for detecting, identifying, and monitoring biological pesticide agents in mammalian cells and the potential for gene exchange.

Radiation: This program provides Federal, regional, State, and local officials with scientifically credible data, methods, and assessments required to determine and control public exposure to radioactive materials in the environment. Emphasis in 1990 will be on increasing the number of demonstrations of techniques for preventing or mitigating exposure to indoor radon gas in new and existing housing structures, homes under construction, and school buildings.

Conservation and land management

Funding for conservation and land management is proposed at $148 million in 1990 which is $5 million above the 1989 level. The Forest Service, accounting for 97 percent of the funding for this subfunction, is scheduled for a 4-percent increase. Each major program will grow by 4 percent. The research challenge cost share program, a new program effective in the 1989 budget, is designed to leverage Federal forestry research dollars in programs benefiting non-Federal client groups. Research funds will be primarily directed to forestry products and harvesting, wildlife and fish habitats, and recreational activities.

Forest Service R&D programs provide land managers and owners with scientific information on the management of timber, forage, wildlife, recreation, and watershed to provide for the continued use and productivity of the Nation's forests and related rangelands. Current areas of research include genetics, silviculture and timber management, watershed management, wildlife, range and fish habitats, recreation, protection of forest resources from fire and forest pests, forest utilization and harvesting, economics of forest commodity production, processing and distribution, and forest inventory and analysis.

R&D budget authority for conservation and land management
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total................................	$141	$143	$148	3.3%
Forest Service (USDA)....................	136	138	143	4.1
Forest protection......................	32	33	35	3.9
Forest and environmental research.......	29	31	32	3.9
Timber management......................	27	27	28	3.7
Resource analysis......................	25	26	27	3.9
Forest products and harvesting research.	20	21	21	3.9
Special competitive grants.............	3	-	-	*
Research challenge cost share...........	-	1	1	0.0
Department of Interior..................	6	6	6	0.0
Bureau of Lands Management.............	3	3	3	0.0
Minerals Management Service............	1	1	1	0.0
Office of Surface Mining and Reclamation......................	1	1	1	0.0
Office of the Secretary................	(a)	(a)	1	25.0

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* Proposed for elimination.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Recreational resources

Support for recreational resources R&D programs, all within the Department of Interior, will decrease by $7 million to $74 million in 1990. The Fish and Wildlife Service (FWS) funds more than three-quarters of total recreational resources R&D. Funding for FWS R&D programs are expected to decrease 12 percent to $55 million. FWS supports research and development relating to the habitats of waterfowl, migratory and non-migratory birds and mammals; the status and distribution of endangered and threatened species; the impact of broadscale environmental changes on fish and wildlife populations and habitat; and on diseases of freshwater and anadromous fish. Proposed decreases in 1990 will focus on fisheries research, wildlife research, and technical development. The National Park Service will expand its R&D activities by 3 percent to $20 million in 1990. Research programs will focus on protecting and preserving the natural and cultural resources of the National Parks.

R&D budget authority for recreational resources
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$78	$81	$74	-8.6%
Fish and Wildlife Service (Interior)	59	62	55	-12.2
Fish and wildlife research and operations	48	49	43	-11.4
Wildlife	15	15	13	-9.5
Contaminants	12	12	12	-3.2
Fisheries	13	15	12	-23.3
Endangered species	5	5	5	-1.9
Research center maintenance	2	2	1	-12.5
Cooperative research units	6	6	6	-7.9
Technical development	6	7	5	-22.1
National Park Service (Interior)	19	19	20	2.6

SOURCE: National Science Foundation, SRS

Water resources

The 1990 R&D budget request for water resources is $41 million--an increase of $3 million from the 1989 level. This growth is attributable to the R&D programs of the Army Corps of Engineers (Corps) within DOD and the Bureau of Reclamation within the Department of Interior. R&D activities of the Corps are expected to rise 5 percent to $36 million. The growth for 1990 funding is equally distributed among the separate R&D activities within the Corps. More funding is proposed for R&D construction, operations, and maintenance, coastal engineering, flood control and navigation, materials research, environmental quality, water resources planning, and surveying and remote sensing. Efforts will focus on dam safety, protection of coastal areas, navigation, flood control, ice and its effects on navigation and flooding, environmental impacts in wetlands, and effects of contaminant mobility and toxic substances in dredged materials.

R&D budget authority for water resources
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$38	$38	$41	7.1%
Army Corps of Engineers (DOD)	33	35	36	4.9
R&D construction operations and maintenance	18	17	18	4.7
Coastal engineering	5	6	6	5.4
Flood control and navigation	4	4	5	4.7
Materials research	2	3	3	3.7
Environmental quality	2	2	2	5.6
Water resources planning studies	2	2	2	6.7
Surveying and remote sensing	1	1	1	8.3
Coastal engineering research board	(a)	(a)	(a)	0.0
Bureau of Reclamation (Interior)	5	4	5	28.6

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Other natural resources

This subfunction includes all programs that are not classifiable under the other groups in the natural resources and environment function and represents about 43 percent of the funding for the function. It is comprised of the R&D programs of three agencies: the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and the Bureau of Mines. These programs are scheduled for a $122 million decrease in 1990 to $493 million.

R&D programs of the U.S. Geological Survey within the Department of Interior are scheduled to decrease 4 percent to $232 million. These R&D programs provide scientific data and information on the Nation's water, land, and mineral resources. All major programs, except the national, mapping, geography and survey program, are expected to have modest reductions in their R&D funding in 1990.

R&D budget authority for the National Oceanic and Atmospheric Administration within the Department of Commerce is scheduled to drop significantly to $189 million. These decreases reflect the Administration's policy of reduced support in areas deemed more appropriately the responsibility of State and local governments or private industry. The proposed 1990 budget includes the termination of a number of programs including, the Saltonstall/Kennedy grant programs, National Sea Grant College Program, and some programs of the National Marine Fisheries Service. The National Weather Service is expected to reduce its R&D funding, with most of the decline attributed to proposed decreases in the Automated Weather Interactive Processing System (AWIPS) program.

R&D programs of the Bureau of Mines within the Department of Interior are expected to decrease 25 percent to $72 million in 1990. The Bureau of Mines conducts research to improve an understanding of the principles of mining and minerals processing and to reduce associated health, safety, and environmental hazards. Reductions are proposed for some projects which are considered more appropriate for support by non-Federal sources.

R&D budget authority for other natural resources
[Dollars in millions]

	1988 actual	1989 estimated	1990 estimated	Percent change 1989-1990 estimated
Total	$604	$615	$493	-19.8%
U.S. Geologic Survey (Interior)	236	240	232	-3.5
Geologic and mineral resource surveys and mapping	138	139	134	-3.3
Geologic hazards surveys	38	37	35	-5.3
Mineral resource surveys	33	33	32	-2.7
Offshore geologic surveys	23	24	25	5.9
Geologic framework and processes	25	26	25	-4.7
Energy geologic surveys	19	18	16	-10.4
Water resources investigations	82	82	78	-5.1
National water resources and research and information systems	82	82	78	-5.1
Federal program	50	49	52	5.1
Federal/State cooperative program	23	23	22	-5.7
State programs	9	10	5	-54.5
National mapping, geography and survey	17	19	20	1.5
National Oceanic and Atmospheric Administration (Commerce)	275	278	189	-31.8
Operations, research and facilities	265	270	189	-29.8
Oceanic and atmospheric research	90	93	73	-20.8
National Marine Fisheries Services	93	98	49	-50.6
National Oceans Service	17	16	17	2.4
National Weather Service	26	24	15	-37.8
National Environmental Satellite Data Information Service	9	8	8	0.0
Program support	31	30	28	-8.9
Fishery products promotion and development	9	9	-	*
Bureau of Mines (Interior)	92	96	72	-24.8

* Proposed for elimination.

SOURCE: National Science Foundation, SRS

TRANSPORTATION

R&D funding for transportation is comprised of four separate subfunctions: air, ground, water, and other R&D activities. The Department of Transportation (DOT) and the National Aeronautics and Space Administration account for all of the R&D support in this function. The R&D programs of the Department of Transportation provide information and new technology for the Department's operational and regulatory programs. The transportation R&D programs of NASA are primarily engaged in aeronautical and transatmospheric research and development.

The proposed R&D budget authority for transportation is $1.1 billion in 1990. The 11-percent gain is mainly attributable to a $104 million increase proposed for air transportation research and development and includes the following scheduled changes.

- The aeronautical research and technology programs of NASA are scheduled to rise $67 million to $719 million.

- The transatmospheric research and technology program of NASA is proposed to increase by $29 million.

- The Federal Aviation Administration (FAA) R&D programs will grow 4 percent as a result of expected increases in the air traffic control and aircraft safety programs, with an additional $4 million expected for each program.

- A 17-percent increase is proposed for the operations development program of FAA to a total of $16 million.

R&D budget authority for transportation
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$896	$1,019	$1,129	10.8%
Air transportation	756	876	980	11.9
National Aeronautics and Space Administration	593	702	798	13.7
Aeronautical research and technology	552	652	719	10.3
Transatmospheric research and technology	41	50	79	57.8
Federal Aviation Administration (DOT)	164	174	181	4.2
Air traffic control	93	89	94	4.9
Aircraft safety	19	24	28	17.7
Advanced computer	18	23	19	-19.0
Operations development	10	14	16	17.3
Aviation weather	15	13	13	3.1
Aviation medicine	4	6	7	6.6
Navigation	3	3	3	-9.4
Environment	2	2	2	11.1
Ground transportation (DOT)	114	118	121	2.6
Federal Highway Administration	75	73	75	3.0
National Highway Traffic Safety Administration	28	34	34	2.4
Federal Railroad Administration	9	9	9	2.2
Urban Mass Transportation Administration	2	2	2	-5.9
Water transportation (DOT)	19	19	19	1.1
U.S. Coast Guard	19	19	19	1.1
Other transportation (DOT)	7	7	10	34.2
Office of the Secretary	5	6	8	44.6
Research and Special Programs Administration	2	2	2	0.0

SOURCE: National Science Foundation, SRS

Air transportation

In the 1990 budget, R&D funding for air transportation is expected to rise to $980 million. This is largely attributable to the $67 million increase in NASA's aeronautical research and technology program to a level of $719 million in 1990.

The research and technology base programs will increase to $285 million with all of the individual subprograms gaining funding in 1990. Applied aerodynamics emphasizes research on reduced-drag and turbulent-drag reduction. Propulsion and power, the second largest program, will focus R&D efforts on the fundamental understanding of stationary and rotating turbomachinery flowfields through the development of advanced computational analysis methods and applications at the component and subsystem level. R&D support will continue for controls and guidance research to provide a technology foundation in advanced systems for application to future aerospace vehicles with an emphasis on guidance and control for highly agile aircraft.

The systems technology programs are scheduled to rise to $108 million. The numerical aerodynamic simulation program, the largest component of the systems technology programs, is expected to rise to $36 million. High performance aircraft systems technology will start a new focus on high-speed flight, addressing environmental issues such as ozone depletion, airport noise, and sonic boom. This new thrust will contribute toward the $21 million scheduled increase for the program to a total of $30 million.

In 1990, the transatmospheric research and technology program, will receive an increase of $29 million, or 58 percent more than 1989 funding levels. The objective of this program, supported by NASA in conjunction with Air Force's advanced technology development program, is to develop the technology base for a National Aerospace Plane.

FAA R&D programs are scheduled to grow to $181 million in 1990. The requested funding level is consistent with the needs of the National Airspace System Plan. All programs are proposed for additional funding, except the advanced computer and navigation programs. Major initiatives include continuing support for the traffic alert and collision avoidance system, increasing systems and airport capacity, continuing efforts for advanced traffic management and automated enroute traffic control, development of radars for detection and tracking of severe weather, testing and inspection of aging aircraft, and continuing emphasis on aviation security through the development of devices for the detection of weapons, explosives, and flammable liquids. The air traffic control program and the aircraft safety program are each proposed to increase by $4 million in 1990.

R&D budget authority for the transportation programs of the National Aeronautics and Space Administration

[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$593	$702	$798	13.7%
Aeronautical research and technology	552	652	719	10.3
Research and technology base	204	268	285	6.2
Applied aerodynamics	45	58	63	7.6
Propulsion and power	37	60	61	2.0
Materials and structures	31	34	34	0.9
Flight systems	20	26	34	29.0
Controls and guidance	17	31	31	1.6
Fluid and thermal physics	19	28	28	1.8
Human factors	16	15	15	0.7
Information sciences	15	8	10	20.7
Systems analysis	4	8	9	4.9
Systems technology programs	60	75	108	43.2
Numerical aerodynamic simulation	31	34	36	7.1
High-performance	4	9	30	218.3
Materials and structures	7	16	26	57.7
Advanced propulsion	14	12	12	3.4
Rotorcraft	4	4	4	2.4
Research and program management	289	308	327	5.9
Transatmospheric research and technology (NASA)	41	50	79	57.8

SOURCE: National Science Foundation, SRS

Ground transportation

R&D support for ground transportation is expected to increase to $121 million in 1990. This growth is proposed primarily for the R&D programs of the Federal Highway Administration with emphasis on the planning, design, maintenance, and construction of the nation's highway system. Small funding increases are proposed for two other agencies with R&D activities in ground transportation: the National Highway Traffic Safety Administration and the Federal Railroad Administration. Research funds within these agencies are directed to motor vehicle, highway, and railroad safety. Funding for the R&D programs of the Urban Mass Transportation Administration is expected to remain stable.

Water transportation

Water transportation includes the R&D programs of the U.S. Coast Guard. Funding for these activities are expected to remain at $19 million, unchanged from 1989 levels. The Coast Guard conducts research on improving search and rescue missions, protecting the environment, marine safety, aids to navigation, and on the enforcement of laws and treaties. Water transportation R&D programs within the Maritime Administration were phased out starting in the 1988 budget.

Other transportation

This category includes R&D programs that are not classified under air, ground, or water transportation. The Office of the Secretary of Transportation and the Research and Special Programs Administration (RSPA) account for all of the activities within this subfunction. The Office of the Secretary is proposed to increase funding for R&D activities and will focus efforts on broad-based policy research on domestic and international transportation issues and research in support of licensing and promoting expendable launch vehicles. RSPA R&D activities are proposed to remain unchanged and will continue research efforts in areas such as hazardous materials, pipeline safety, and emergency transportation.

AGRICULTURE

All R&D activities within this function are conducted by the Department of Agriculture (USDA). Funding for research and development at the USDA supports several programs and disciplines to ensure the continued high productivity of U.S. agriculture. Agriculture is proposed to receive $901 million for R&D activities in 1990, a 1-percent, or $9 million, decline from 1989.

Most R&D programs within USDA are proposed to undergo modest growth between 1989 and 1990. The sole reason for the USDA's overall decline is the $29 million decrease scheduled for the Cooperative State Research Service (CSRS). Significant program changes within CSRS are highlighted below.

- The special grants program is proposed to decrease by $43 million to $16 million in 1990, as a result of the termination of several grants activities.
- Animal health and disease research programs, totaling an estimated $6 million in 1989, are proposed for elimination in 1990.
- Competitive research grants are scheduled to grow by 24 percent to $64 million in 1990. The increase is distributed among all grant categories including two recently established ones--Stratospheric ozone and Plant Science Centers.

Research and development for the Agricultural Research Service is proposed to increase by 4 percent, or $21 million, over 1989 to a total of $546 million. Increased funding of particular note is shown below.

- The research on soil and water conservation program is proposed to receive an additional $10 million over the 1989 level to a total of $74 million.
- The research on animal sciences program is proposed to increase by $6 million to $98 million.
- The research on commodity conversion and delivery program is scheduled to rise by $4 million to $109 million in 1990.

R&D budget authority for agriculture (USDA)
[Dollars in millions]

	1988	1989	1990	Percent Change 1989-1990
	actual	estimated		estimated
Total	$882	$910	$901	-1.0%
Agricultural Research Service	509	525	546	4.1
Research on plant sciences	205	208	208	0.2
Research on commodity conversion and delivery	101	105	109	4.6
Research on animal sciences	91	92	98	6.8
Research on soil & water conservation	59	64	74	15.3
Human nutrition research	43	44	44	0.2
Integration of agricultural systems	12	13	13	0.0
Cooperative State Research Service	298	308	279	-9.2
Payments under the Hatch Act	156	156	156	0.0
Competitive research grants	42	40	64	59.9
Biotechnology	19	19	22	13.7
Plant science	12	8	12	51.3
Animal science	6	6	14	133.3
Stratospheric ozone	-	4	7	100.0
Plant science centers	-	-	3	**
Human nutrition	2	1	3	200.0
Pest science	3	2	2	0.0
Payments to 1890 colleges and Tuskegee Institute	23	24	25	4.1
Special grants	47	59	16	-73.2
Cooperative forestry research	18	18	13	-25.7
Forestry competitive grants 1/	3	0	5	
Administration	4	6	1	-81.3
Animal health and disease research	6	6	-	-100.0
Economic Research Service	48	49	52	4.9
Human Nutrition Information Service	9	9	10	8.0
Animal & Plant Health Inspection Service	7	7	7	0.0
National Agricultural Statistics Service	4	4	4	0.0
Agricultural Cooperative Service	3	3	1	-48.1
Office of Transportation	1	1	1	-40.0
Federal Grain Inspection Service	1	1	1	0.0
Office of International Cooperation and Development	2	2	-	*
Agricultural Marketing Service	2	2	-	*

1/ In 1989, funds that the Forest Service was scheduled to transfer to this program were not available.

* Proposed for elimination.

** Proposed new initiative.

Source: National Science Foundation, SRS

Agricultural Research Service

In 1990, R&D activities at the Agricultural Research Service (ARS) will focus on water quality, food quality and safety, and plant and animal germplasm preservation. Programs scheduled to increase in 1990 include: research on commodity conversion and delivery, animal sciences, and soil and water conservation. The remaining three programs' funding will be maintained at 1989 levels.

Cooperative State Research Service

The majority of the R&D activities within the CSRS are conducted at universities and colleges. Although an overall decrease for R&D activities is proposed for CSRS, many programs are scheduled to increase over 1989 levels. The payments under the Hatch Act program, which accounts for 56 percent of CSRS funding, is scheduled to remain level. The 1990 budget authority for R&D activities includes moderate increases for each of the competitive research grants programs and the addition of two new programs, stratopheric ozone and plant science centers (established in 1989 and 1990 respectively). Payments to the "1890" colleges and Tuskegee Institute are expected to increase only slightly over 1989. The largest and most significant decline is scheduled for the special grants program as a result of the elimination of several grants within the program. Funding is expected to resume in 1990 for forestry competitive grants after receiving no funding in 1989. The remaining programs, cooperative forestry research, administration, and animal health and disease research, are scheduled for decreased funding levels from 1989 or are proposed for elimination.

Economic Research Service

The Economic Research Service's (ERS) R&D programs are all scheduled to receive moderate increases over 1989. These programs include agriculture and rural economy, agriculture and trade analysis, commodity economics, and resources and technology.

Other departmental programs

The R&D programs within the Office of International Cooperations and Development and the Agricultural Marketing Service are scheduled for elimination in 1990. All other agriculture programs are expected to remain essentially the same except for the Agricultural Cooperative Service and the Office of Transportation, which are expected to decrease.

EDUCATION, TRAINING, EMPLOYMENT, AND SOCIAL SERVICES

R&D activities within this function are conducted by the Department of Education, the Office of Human Development Services of the Department of Health and Human Services, the Smithsonian Institution, and the Department of Labor.

The proposed R&D budget authority for education, training, employment, and social services is $347 million, a 1-percent increase from the $343 million level in 1989. Highlights of the major R&D program emphases in 1990 follow.

- R&D support for social services will increase by $2 million to $159 million.
- An increase of $1 million in the research and general education aids is proposed with an increased emphasis on programs of the Smithsonian Institution.
- An overall increase in support for other labor services results primarily from growth in the R&D programs of the Bureau of Labor Statistics and the Pension Welfare Benefits Program.
- R&D support for training and employment will remain unchanged at $7 million.

R&D budget authority for education, training, employment, and social services

[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$285	$343	$347	1.2%
Research and general education aids	160	165	166	1.0
Smithsonian Institution	79	82	89	8.5
Department of Education	81	83	77	-6.4
Education and research statistics	27	27	31	12.9
Education for the handicapped	21	21	21	0.0
Special institutions	7	7	8	4.1
Chapter 1 evaluation and technical assistance	4	6	7	29.1
Bilingual education	3	3	3	0.0
Fund for information in education	0	1	2	283.3
Vocational and adult education	14	15	2	-86.4
International education in foreign language studies	1	1	1	0.0
Library research and demonstrations	(a)	(a)	1	300.0
Drug-free schools and communities national program	1	1	1	0.0
Science and mathematics programs of national significance	2	1	1	0.0
Fund for the improvement of postsecondary education	(a)	(a)	(a)	0.0
Ch. 2 Secretary's discretionary fund	1	-	-	*
Social services	104	157	159	0.9
Human Development Services (HHS)	52	103	103	0.5
Rehabilitation services and handicapped research (Education)	52	55	56	1.6
Training and employment	7	7	7	0.0
Employment and Training Adm. (Labor)	7	7	7	0.0
Other labor services (Labor)	14	14	15	6.4
Bureau of Labor Statistics	7	7	8	13.9
Pension Welfare Benefits Program	2	1	2	150.0
Bureau of Labor-Management Relations and Competitive Programs	(a)	(a)	(a)	0.0
Employment Standards Administration	(a)	(a)	(a)	0.0
Departmental management	4	6	4	-23.6

* Scheduled for termination.

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Research and general education aids

The programs under this category account for almost 48 percent of the 1990 R&D funding and are expected to increase approximately 1 percent to $166 million. R&D support for the Smithsonian Institution is proposed to grow $7 million, or 9 percent, to $89 million. The Smithsonian conducts original scientific research in several fields including biology, geology, oceanography, atmospheric science, and anthropology. The increase in funding will be directed toward the development of the submillimeter telescope array and the multiple mirror telescope.

The Department of Education accounts for approximately one-half of the funding within this subfunction. These programs are scheduled to decrease by $5 million to $77 million. The reduction in funding of the research and general education aids of the Department of Education is attributable to an 86-percent drop in support for vocational and adult education. Emphasis in 1990 is directed toward general research and development for improving the quality of education.

Support for education and research statistics, the largest education R&D program within the Department of Education, is expected to increase to $31 million.

Initiated in 1989, the fund for information in education program is proposed for a 1990 funding level of over $2 million. This program is comprised of projects that identify and disseminate innovative educational approaches, including computer-based education and technology education.

Library and research demonstration programs are expected to increase significantly to a total of $1 million in 1990. An increase is also proposed for chapter 1 evaluation and technical assistance. R&D programs for special institutions are expected to increase 4 percent to $8 million in 1990.

Social services

R&D activities classified under social services are comprised of programs within the Office of Human Development Services (HHS) and the Department of Education. The R&D programs of the Office of Human Development Services are proposed to remain virtually unchanged at $103 million in 1990. R&D funding for all activities in this office have been consolidated under one budget category in 1990. Research efforts will focus on runaway and homeless youth, child abuse, youth drug prevention, child welfare, adoption opportunities, and aging and developmental disabilities.

The rehabilitation services and handicapped research program of the Department of Education is expected to increase 2 percent to $56 million. The purpose of research under this program is to identify the causes and consequences of disability and to discover new ways of maximizing the personal autonomy, self sufficiency, development, health, physical, and emotional status of disabled persons.

R&D budget authority for social services
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$104	$157	$159	0.9%
Department of Health and Human Services				
Office of Human Development Services	52	103	103	0.5
Human services research, training, demonstration, and evaluation 1/	-	-	103	
Administration for children, youth and families	29	80	NA	
Administration for native americans	1	1	NA	
Administration on aging	14	14	NA	
Administration on developmental disabilities	3	3	NA	
Social services research	6	5	NA	
Department of Education				
Rehabilitative services and handicapped research	52	55	56	1.6

1/ R&D funding for all activities within the Office of Human Development Services have been consolidated under one budget category in 1990.

NA Data not available.

SOURCE: National Science Foundation, SRS

Training and employment

In the 1990 budget, R&D programs conducted by the Employment and Training Administration remain unchanged from funding levels for 1989 at $7 million. R&D funding provides support for studies directed to immediate and long-range labor market problems. Major objectives include studies on improving the training and employment system, improving forecasting techniques, and utilizing projections of labor demand and supply, and skill requirements to develop training programs corresponding to the needs of the labor force.

Other labor services

Programs classified under other labor services include all labor-related R&D activities, other than employment and training. R&D support for other labor services is proposed to increase 6 percent to $15 million. The largest program within other labor services is supported by the Bureau of Labor Statistics (BLS). Resources are primarily assigned toward research designed to maintain the quality, relevance, and timeliness of the Bureau's statistical and analytical output. Research is also directed towards analyses on the behavior of employment, prices, wages and productivity in the economy. The increase in funding for BLS is attributed to two changes in research activities. The transfer of the National Longitudinal Survey from the Employment and Training Administration to the BLS and the recent Congressional funding for the development of the BLS Survey Design Research Center.

The second largest R&D program, under other labor services, is labeled as departmental management but consists of R&D activities supported by three separate offices: (1) the Office of the Assistant Secretary for Policy which will emphasize research on the efficient use of scarce enforcement resources, immigration and its impact on the workforce, regulatory reform, the efficiency of human capital markets, pension regulation policy, and youth unemployment; and (2) the International Labor Affairs Bureau that will conduct research on the impact of changes in U.S. international economic policies on the welfare of U.S. workers; and (3) the Women's Bureau which will emphasize research support on issues related to the dominance of women in the service economy, the international economy as it relates to job flight, and other issues affecting the welfare of wage-earning women.

VETERANS BENEFITS AND SERVICES

All R&D activity within the veterans benefits and services function is funded through the Veterans Administration (VA). The VA conducts and administers a program of medical, rehabilitation, and health services research designed to improve the quality and effectiveness of health care for the veteran. In 1990, R&D programs account for about 1 percent of total Federal budget authority for this function.

In 1990, the R&D budget request for the VA is $199 million, a decrease of $13 million below 1989. This is primarily attributable to the reduction in funding for investigator-initiated studies.

Highlights of the major VA programs emphasized in the 1990 budget follow.

- Investigator-initiated studies, which comprise about three-quarters of medical and prosthetic research, are expected to be $130 million in 1990, a decrease of $9 million from 1989. Special emphasis within the medical research program is given to Agent Orange, aging, alcoholism, post-traumatic stress, health problems of former prisoners of war, and Acquired Immune Deficiency Syndrome (AIDS).

- Both the rehabilitation research and health services research programs are expected to remain unchanged from 1989 levels. Rehabilitation research is directed toward providing health care services for aging and disabled veterans including devices that minimize their disability and enhance the quality of their lives. The goal of health systems research and development is to assist the search for the most cost-effective approaches to delivering quality health care to veterans.

- Funding for most of the remaining VA's R&D programs is proposed to decrease or remain at 1989 levels, except for both the women's epidemiology study and the CDC's epidemiology study, for which no funds are expected.

R&D budget authority for veterans benefits and services
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$195	$212	$199	-6.2%
Veterans Administration				
Medical and prosthetic research	164	182	169	-7.1
Investigator-initiated studies	122	139	130	-6.6
Career development	18	19	18	-2.7
Cooperative studies	14	15	14	-3.4
Special research initiatives	3	6	6	-8.2
Agent orange studies	2	2	2	-6.3
Epidemiology study (CDC)1/	3	2	-	*
Women's epidemiology study	2	-	-	*
Rehabilitation research	21	19	19	0.0
Health services research	8	9	9	0.0
Medical administration and miscellaneous operating expenses	2	2	2	-5.0

1/ Management of the resources associated with this study is the responsibility of the Department of Health and Human Services (HHS) through the Centers for Disease Control (CDC) in Atlanta, Georgia.

* Proposed for elimination.

SOURCE: National Science Foundation, SRS

INTERNATIONAL AFFAIRS

All R&D activity within the international affairs function is conducted by the Agency for International Development (AID). The budget authority request for AID's R&D programs in 1990 is $169 million, an increase of $29 million above 1989 funding. R&D activities in 1990 comprise about 1 percent of total Federal budget authority for this function.

Increased emphasis is proposed in 1990 for Asia and Near East activities. In general, R&D activities within this function focus on solving specific problems associated with basic human needs and on social and economic research aimed at understanding the barriers to development. R&D priorities reflect the important development problems faced by the Third World: food and agriculture, health and population, education and human resources, energy and natural resources, and small enterprise development.

R&D budget authority for international affairs
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$224	$141	$169	20.5%
Agency for International Development				
Science & technology	102	90	91	0.4
Asia and Near East	12	8	17	111.5
Science advisor	13	7	7	0.0
Latin America	16	7	6	-20.3
Africa	11	2	3	81.2
Private enterprise	1	1	1	0.0
Program policy coordination	68	26	46	75.9

SOURCE: National Science Foundation, SRS

COMMERCE AND HOUSING CREDIT

Commerce and housing credit R&D funding is scheduled to decrease by $2 million to a level of $132 million in 1990. R&D funds will account for about 1 percent of total Federal budget authority for this function in 1990. Most funding for this function is for R&D programs of the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards) within the Department of Commerce. R&D programs focus on the development and maintenance of a system of measurements required to support the Nation's industrial and scientific endeavors.

In 1990, NIST has requested increases for R&D programs in chemical measurements and standards, high performance composites, lightwave measurement technology, bioprocess engineering, high temperature superconductors, computer security, and supercomputer upgrade. Decreases are requested in fire and building research programs (part of the engineering measurements and standards program) and activities associated with the Center for Integrated Design under the industrial technology services program are proposed for elimination.

R&D budget authority for commerce and housing credit
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$122	$134	$132	-1.5%
Department of Commerce				
National Institute of Standards and Technology	108	121	118	-2.1
Engineering measurements and standards	38	40	40	-0.5
Measurement research and standards	34	35	37	3.4
Materials science and engineering	18	19	20	5.2
Computer sciences and technology	7	8	11	31.3
Industrial technology services	-	8	-	*
Research support activities	10	11	11	2.9
National Telecommunications and Information Administration	8	8	8	5.1
Bureau of the Census	6	5	6	3.7

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* Proposed for elimination.

SOURCE: National Science Foundation, SRS

COMMUNITY AND REGIONAL DEVELOPMENT

Proposed R&D funding for community and regional development programs is scheduled to increase by $2 million from 1989, to $79 million in 1990. R&D programs comprise about 1 percent of total Federal budget authority for this function in 1990. About three-fourths of all funding for this function is for the Tennessee Valley Authority (TVA). Most of TVA's funding is directed toward the development of technologies to assist in keeping electric rates at the lowest level possible; to research, develop, and transfer technology of new fertilizer products and fertilizer use; to define and develop processes to economically produce ethanol and marketable by-products from hardwoods and wood processing wastes; to develop innovative new technologies and techniques to protect and enhance the environment; and to assist in the regional economy to improve the quality of life for the people of the Tennessee Valley and the Nation. Most of the increase in R&D support for the Department of Housing and Urban Development in 1990 is for housing markets and housing programs.

R&D budget authority for community and regional development
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$108	$77	$79	2.3%
Tennessee Valley Authority	86	59	57	-2.2
Department of Housing and Urban Development	18	17	22	25.0
Housing markets	14	13	14	11.7
Housing programs	2	1	4	233.3
Fair housing	1	1	1	12.5
Safety and standards	1	2	1	-62.5
Local government management	(a)	(a)	(a)	75.0
Research support	1	1	1	7.7
Department of Commerce Economic Development Administration	4	1	-	*

(a) Less than $500,000.
* Proposed for elimination.

SOURCE: National Science Foundation, SRS

ADMINISTRATION OF JUSTICE

R&D programs within the administration of justice function are conducted by the Department of Justice and the U.S. Customs Service within the Department of Treasury. In 1990, R&D funding for the administration of justice is scheduled to decrease by $5 million, or 11 percent, to $40 million. R&D programs account for one-half of 1 percent of total Federal budget authority for this function. About one-half of this function's R&D funding is for the Department of Justice's Office of Justice programs. Emphasis is placed on research, development, evaluation, and dissemination activities to produce knowledge about the causes and control of crime and to deal with the complex problems of juvenile delinquency.

R&D budget authority for administration of justice
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$51	$45	$40	-11.0%
Department of Justice	41	38	33	-13.1
Office of Justice Programs	22	25	22	-14.3
Federal Bureau of Investigation	12	5	5	0.0
Federal Prison System	6	6	4	-31.1
Drug Enforcement Administration	2	1	2	50.0
Immigration and Naturalization Service	(a)	(a)	(a)	0.0
U.S. Customs Service (Treasury)	10	8	8	-1.3

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

INCOME SECURITY

Federal programs in the income security function are directed toward assistance in meeting the needs of individuals by insuring against loss of income resulting from disability, retirement, death or unemployment of a wage earner, and by helping the truly needy who can not provide for themselves. Federal R&D activities within the income security function are supported by the Department of Health and Human Services and the Pension Benefit Guarantee Corporation. In 1990, income security R&D programs are proposed to decrease by 8 percent, or $2 million, below 1989 levels to $25 million. R&D activities will account for only a fraction of 1 percent of total Federal budget authority for this function in 1990.

R&D budget authority for income security
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$23	$27	$25	-7.9%
Department of Health and Human Services	22	26	24	-7.6
Social Security Administration	15	16	17	5.7
Family Support Administration	3	3	3	0.0
Departmental Management	5	8	5	-36.7
Pension Benefit Guarantee Corp	(a)	(a)	(a)	-33.3

(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

GENERAL GOVERNMENT

The general government function includes the central management activities for both the executive and legislative branches of the Federal Government. Major activities of this function are Federal finances, tax collection, personnel management, and property control. Federal R&D activities within the general government function are supported by the Internal Revenue Service and the U.S. Mint, both within the Department of Treasury. General government funding for research and development will increase by 13 percent to $17 million in 1990 attributable to proposed R&D efforts at the Internal Revenue Service. R&D activities within this function will account for only a fraction of 1 percent of total Federal budget authority for general government in 1990.

R&D budget authority for general government
[Dollars in millions]

	1988	1989	1990	Percent change 1989-1990
	actual	estimated		estimated
Total	$17	$15	$17	13.2%
Department of Treasury				
Internal Revenue Service	14	14	17	18.8
U.S. Mint	3	1	-	*

* Proposed for elimination.

SOURCE: National Science Foundation, SRS

APPENDIX: HISTORICAL TRENDS

Federal R&D obligations by selected budget function: fiscal years 1955-60
[Dollars in millions]

Function	1955	1956	1957	1958	1959	1960
Total	$2,533	$2,988	$3,932	$4,570	$6,694	$7,552
National defense	2,151	2,535	3,327	3,801	5,556	6,107
Health	67	83	140	177	233	305
All other functions	315	370	465	592	904	1,140

SOURCE: National Science Foundation, SRS

Federal R&D obligations by selected budget function: fiscal years 1961-66
[Dollars in millions]

Function	1961	1962	1963	1964	1965	1966
Total	$9,059	$10,290	$12,495	$14,225	$14,614	$15,320
National defense	7,005	7,238	7,764	7,829	7,342	7,536
Health	405	551	626	728	792	900
Space research and technology	777	1,413	2,812	4,241	4,887	4,976
General science	137	187	246	277	304	377
Energy	373	448	515	571	585	575
Natural resources and environment	73	108	120	134	159	189
Transportation	55	101	142	122	147	251
Agriculture	125	136	146	165	195	201
All other functions	108	107	125	160	203	315

SOURCE: National Science Foundation, SRS

Federal R&D obligations by budget function: fiscal years 1967-72
[Dollars in millions]

Function	1967	1968	1969	1970	1971	1972
Total	$16,529	$15,921	$15,641	$15,339	$15,543	$16,496
National defense	8,566	8,275	8,356	7,981	8,110	8,902
Health	915	1,021	1,088	1,084	1,288	1,547
Space research and technology	4,778	4,304	3,799	3,606	3,048	2,932
General science	409	437	433	452	513	625
Energy	600	657	597	574	556	574
Natural resources and environment	320	331	323	340	416	479
Transportation	380	304	404	535	728	558
Agriculture	218	217	221	238	259	294
Education, training, employment and social services	154	166	169	164	215	235
Veterans benefits and services	41	45	50	59	63	69
International affairs	18	17	26	32	32	29
Commerce and housing credit	43	48	54	79	90	50
Community and regional development	37	44	32	47	65	66
Administration of justice	(a)	1	5	9	10	23
Income security	48	50	78	136	145	106
General government	3	5	5	6	7	8

Note: Data are shown in obligations.
(a) Less than $500,000.

SOURCE: National Science Foundation, SRS

Federal R&D obligations by budget function: fiscal years 1973-78
[Dollars in millions]

Function	1973	1974	1975	1976	1977	1978
Total	$16,800	$17,410	$19,039	$20,780	$23,450	$25,976
National defense	9,002	9,016	9,679	10,430	11,864	12,899
Health	1,585	2,069	2,170	2,351	2,629	2,968
Space research and technology	2,824	2,702	2,764	3,130	2,832	2,939
General science	658	749	813	858	974	1,050
Energy	630	759	1,363	1,649	2,562	3,134
Natural resources and environment	554	516	624	683	753	904
Transportation	572	693	635	631	708	768
Agriculture	308	313	342	383	457	501
Education, training, employment and social services	290	236	239	255	230	345
Veterans benefits and services	74	85	95	98	107	111
International affairs	28	24	29	42	66	57
Commerce and housing credit	50	51	65	69	71	77
Community and regional development	78	82	93	109	101	92
Administration of justice	33	35	44	35	30	44
Income security	106	71	72	48	55	67
General government	7	9	12	12	13	20

Note: Data for 1973-77 represent obligations. Data for 1978 are shown in actual budget authority.

SOURCE: National Science Foundation, SRS

Federal R&D funding by budget function: fiscal years 1979-84
[Dollars in millions]

Function	1979	1980	1981	1982	1983	1984
Total	$28,208	$29,739	$33,735	$36,115	$38,768	$44,214
National defense	13,791	14,946	18,413	22,070	24,936	29,287
Health	3,401	3,694	3,871	3,869	4,298	4,779
Space research and technology	3,136	2,738	3,111	2,584	2,134	2,300
General science	1,119	1,233	1,340	1,359	1,502	1,676
Energy	3,461	3,603	3.501	3,012	2,578	2,581
Natural resources and environment	1,010	999	1,061	965	952	963
Transportation	798	887	869	791	876	1,040
Agriculture	552	585	659	693	745	762
Education, training, employment and social services	354	468	298	228	189	200
Veterans benefits and services	123	126	143	139	157	218
International affairs	117	125	160	165	177	192
Commerce and housing credit	93	101	106	104	107	110
Community and regional development	127	119	104	63	44	46
Administration of justice	47	45	34	31	37	24
Income security	57	47	43	32	32	26
General government	23	22	22	10	6	8

Note: Data are shown in actual budget authority.

SOURCE: National Science Foundation, SRS

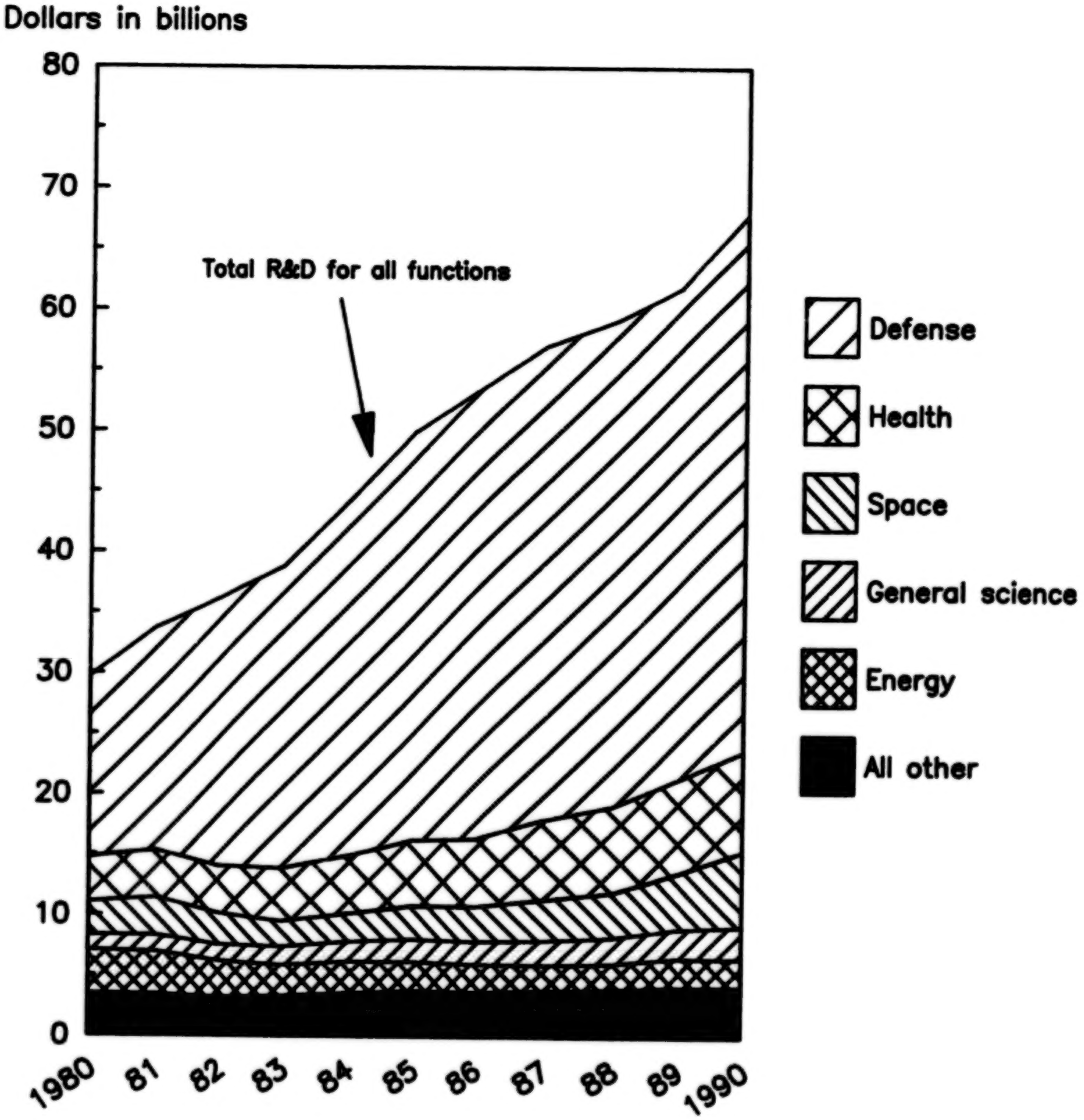
Federal R&D funding by budget function: fiscal years 1985-90
[Dollars in millions]

Function	1985	1986	1987	1988	1989 est	1990 est
Total	$49,887	$53,249	$57,069	$59,106	$61,823	$67,833
National defense	33,698	36,926	39,152	40,099	40,574	44,295
Health	5,418	5,565	6,556	7,076	7,724	8,229
Space research and technology	2,725	2,894	3,398	3,683	4,589	6,146
General science	1,862	1,873	2,042	2,160	2,379	2,652
Energy	2,389	2,286	2,053	2,126	2,427	2,333
Natural resources and environment	1,059	1,062	1,133	1,160	1,208	1,140
Transportation	1,030	917	908	896	1,019	1,129
Agriculture	836	815	822	882	910	901
Education, training, employment and social services	220	248	267	285	343	347
Veterans benefits and services	193	183	215	195	212	199
International affairs	210	211	223	224	141	169
Commerce and housing credit	114	111	110	122	134	132
Community and regional development	50	88	99	108	77	79
Administration of justice	47	41	49	51	45	40
Income security	21	14	25	23	27	25
General government	17	14	17	17	15	17

Note: Data for 1985-88 are shown in actual budget authority. Data for 1989 and 1990 are estimates based on the FY 1990 budget.

SOURCE: National Science Foundation, SRS

R&D budget authority by major function



SOURCE: National Science Foundation, SRS

Budget authority for basic research by function: fiscal years 1978-84
[Dollars in millions]

Function	1978	1979	1980	1981	1982	1983	1984
Total	$3,665	$4,108	$4,716	$5,107	$5,305	$6,247	$7,072
Health	1,246	1,579	1,761	1,951	1,953	2,475	2,813
General science	962	1,026	1,152	1,256	1,296	1,439	1,606
Space research and technology	412	440	482	445	434	501	646
National defense	320	365	552	610	696	788	845
Energy	157	172	200	220	260	320	365
Agriculture	197	222	246	281	295	326	353
Natural resources and environment	207	131	136	131	139	156	
Transportation	70	75	79	89	102	117	125
Education, training, employment and social services	57	59	61	66	78	70	77
Commerce and housing credit	9	10	15	17	17	19	20
Veterans benefits and services	9	10	14	15	13	14	15
Administration of justice	10	10	9	5	4	4	5
Community and regional development	8	8	8	5	7	6	5
General government	-	(a)	(a)	3	2	3	
International affairs	(a)	-	-	12	10	10	3
Income security	2	1	1	3	-	-	-

(a) Less than $500,000.

Note: Data are shown in actual budget authority. Data are not available prior to FY 1978.

SOURCE: National Science Foundation, SRS

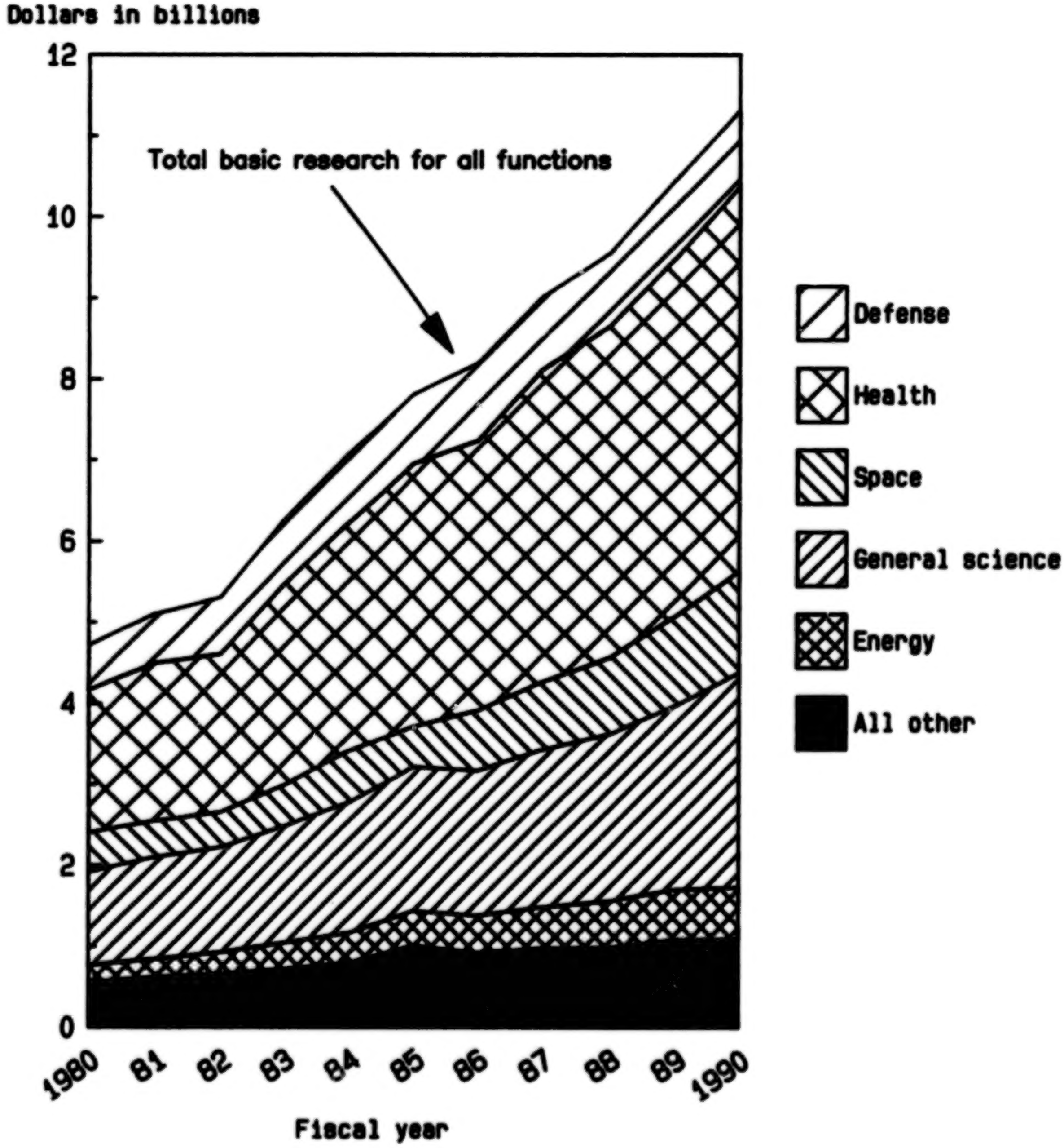
Budget authority for basic research by function: fiscal years 1985-90
[Dollars in millions]

Function	1985	1986	1987	1988	1989 est	1990 est
Total	$7,810	$8,193	$9,021	$9,553	$10,449	$11,192
Health	3,243	3,324	3,851	4,087	4,416	4,756
General science	1,779	1,795	1,942	2,061	2,268	2,525
Space research and technology	498	737	843	944	1,101	1,243
National defense	856	960	900	905	968	939
Energy	428	456	511	571	614	634
Agriculture	406	390	397	428	438	457
Natural resources and environment	206	204	206	210	244	262
Transportation	255	184	231	197	249	226
Education, training, employment and social services	86	83	78	83	86	94
Commerce and housing credit	23	26	26	28	28	28
Veterans benefits and services	15	15	17	17	19	15
Administration of justice	4	5	8	8	10	6
Community and regional development	6	6	4	7	5	4
General government	4	5	4	5	3	3
International affairs	4	5	3	3	2	1
Income security	-	-	-	-	-	-

Note: Data for 1985-88 are shown in actual budget authority. Data for 1989 and 1990 are estimates based on the FY 1990 budget.

SOURCE: National Science Foundation, SRS

Basic research budget authority by major function



SOURCE: National Science Foundation, SRS

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